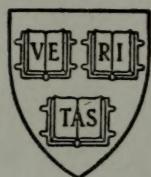


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W.D. GRIFFITH & COMPANY,
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Sixty-Second Annual Report

OF THE

Entomological Society of Ontario

1931

PRINTED BY ORDER OF

HON. T. L. KENNEDY, Minister of Agriculture



ONTARIO

TORONTO

Printed by the Printer to the King's Most Excellent Majesty

1932

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Entomological Society of Ontario

OFFICERS FOR 1931-32

President—DR. W. H. BRITTAINE, Macdonald College, Quebec.

Vice-President—W. A. ROSS, Entomological Laboratory, Vineland Station, Ontario.

Secretary-Treasurer—R. H. OZBURN, O. L. College, Guelph, Ont.

Librarian—MISS ROSE KING, O. A. College, Guelph, Ontario.

Directors—ARTHUR KELSALL, Dominion Entomological Laboratory, Annapolis Royal, Nova Scotia; G. CHAGNON, University of Montreal, Montreal, Quebec; W. J. BROWN, Entomological Branch, Ottawa; PROFESSOR A. V. MITCHENER, Manitoba Agricultural College, Winnipeg, Manitoba; PROFESSOR E. H. STRICKLAND, University of Alberta, Edmonton, Alberta; R. GLENDENNING, Dominion Entomological Laboratory, Agassiz, B.C.

Directors (ex-presidents)—PROF. JOHN DEARNESS, London; PROF. E. M. WALKER, University of Toronto; ALBERT F. WINN, Westmount, Que; PROF. LAWSON CAESAR, O. A. College, Guelph; ARTHUR GIBSON, Dominion Entomologist, Ottawa; F. J. A. MORRIS, Peterborough; DR. J. H. SWAINE, Entomological Branch, Ottawa; REV. FATHER LEOPOLD, La Trappe, Que.; PROF. A. W. BAKER, O. A. College, Guelph, Ont.; T. D. JARVIS, Ontario Research Foundation, Toronto; J. D. DETWILER, Western University, London, Ontario.

Editor—DR. J. H. McDUNNOUGH, Entomological Branch, Ottawa.

Editorial Board—H. G. CRAWFORD, Entomological Branch, Ottawa; PROF. G. J. SPENCER, University of British Columbia, Vancouver, B.C.; DR. W. H. BRITTAINE, Macdonald College, Quebec; J. B. WALLIS, Winnipeg, Manitoba.

Auditors—L. CAESAR, O. A. College, Guelph; A. W. BAKER, O. A. College, Guelph.

ENTOMOLOGICAL SOCIETY OF ONTARIO

FINANCIAL STATEMENT

FOR THE YEAR ENDING OCTOBER 31ST., 1931

<i>Receipts</i>		<i>Expenditures</i>	
Cash on hand, 1930.....	\$ 666.23	Printing.....	\$1,410.00
Subscriptions.....	545.30	Annual Meeting.....	100.76
Dues.....	153.55	Expense.....	79.35
Advertisements.....	253.11	Cuts.....	30.01
Back Numbers.....	377.97	Salaries.....	290.00
Government Grant.....	1,000.00	Reprints of Back Numbers.....	400.00
Exchange.....	.15	Insurance.....	39.00
Interest.....	36.01	Delegate to Royal Society Meeting.....	9.00
		Exchange.....	16.14
		Balance on hand.....	658.06
	\$3,032.32		\$3,032.32

Respectfully submitted,

REG. H. OZBURN,

Secretary-Treasurer.

Auditors—L. CAESAR, A. W. BAKER.

Entomological Society of Ontario

REPORT OF THE COUNCIL

The Council of the Entomological Society of Ontario begs to present its report for the year 1930-1931.

The Sixty-seventh Annual Meeting of the Society was held at the Chateau Laurier, Ottawa, Thursday, Friday and Saturday, November 6th, 7th and 8th, 1930.

The morning and afternoon sessions, held in the Chateau Laurier, were well attended. About 70 members and visitors were present during the course of the meetings, which were largely devoted to reading of papers and discussion.

The Thursday evening meeting was held in the Ladies' Cafe of the Chateau, Dr. J. H. Grisdale, Deputy Minister of Agriculture, acting as Chairman. Dr. James G. Needham, Professor of Entomology and Limnology, Cornell University, Ithaca, N.Y., gave a very interesting address on "War—a Biological Phenomenon".

On Friday evening the members of the Society and their friends were the guests of the Entomological Branch, Dominion Department of Agriculture, at a smoker held in the Halcyon Club. Mr. Arthur Gibson, Dominion Entomologist, acted as Chairman, Mr. Frank Morris, Peterborough, gave an interesting paper on "An Entomologist in Algonquin", and Mr. T. Wayling, Press Gallery, Ottawa, spoke on "Across the Atlantic in the R-100".

The Canadian Entomologist, the official organ of the Society, completed its sixty-second volume in December last. The volume contained 288 pages, illustrated by 21 full page plates and 33 original figures. The contributors to these pages numbered 45 and included writers in Ontario, Quebec, Manitoba, Alberta, British Columbia and also in 18 of the United States. Thirteen papers were published during the year of a general or economic nature.

It is the sad duty of the Council to record the loss of Mr. John D. Evans of Toronto, one of the older members of the Society. Mr. Evans died at Toronto last November, during the Society's 1930 Annual Meeting.

REPORT OF THE CURATOR AND LIBRARIAN

The Society's collections have been examined from time to time and the necessary steps taken to prevent injury from museum pests. At the present time they are in good condition.

Many additions have been made to the Society's library. Several new exchanges have been effected with foreign periodicals and a few missing back numbers of periodicals already in the library have been secured. The work of re-arranging and indexing the whole library has been continued.

REPORT OF THE MONTREAL BRANCH

The 58th Annual Meeting of this Branch was held on May 16th, 1931, in the Lyman Entomological Room, Redpath Museum, McGill University, Montreal.

The usual eight meetings were held during the season in the Lyman Room, and at the residences of members, with an average attendance of 15. We held a public meeting in the Moyse Hall in December, 1930, when Mr. G. H. Hall delivered a lecture, illustrated with lantern slides, and in February, 1931, our President, Mr. Geo. A. Moore, lectured on Insect Life at a meeting of the Province of Quebec Society for the Protection of Birds. For the second season a prize was donated by the Branch for the best collection of Insects at the Boy Scouts' Hobby Exhibition in the Central Y.M.C.A.

The following papers were read during the year:—

“The Study of Entomology”—G. A. Moore.

“Ovipositing of *Vanessa antiopa*”—J. W. Buckle.

“Biology of the Mosquito of Permanent Water Bodies”—G. H. Fisk.

“Hemiptera of Peake's Island in 1930”—G. A. Moore.

“Natural Enemies, Plants and Animals, of the Mosquito”—G. H. Fisk.

“Insect Life Histories and Habits, including the Honey Bee”—G. H. Hall

“Insects of the Laurentian Mountains and the effects of Cyanide on certain Butterflies”—A. F. Winn.

“Respiratory System of Insects”—G. H. Fisk.

“Egg laying of *Argynnis myrina*”—A. F. Winn.

“Noise made by *Vanessa j-album* while in Flight”—A. F. Winn.

“Hemiptera-Heteroptera of Peake's Island”—G. A. Moore.

“Cicadellinæ”—G. A. Moore.

“Use of the Larvae of the Blowfly in cases of Chronic Osteomyelitis”—G. H. Fisk.

“Remarks on Tabanidae”—G. Chagnon.

The Treasurer's Report showed a balance on hand of \$195.74.

The following were elected officers for the season:—President, Albert F. Winn; Vice-President, G. H. Hall; Secretary-Treasurer, J. W. Buckle; Council, G. A. Moore, G. Chagnon, A. C. Sheppard and G. H. Fisk.

Respectfully submitted,

J. W. BUCKLE, *Secretary*.

REPORT OF THE BRITISH COLUMBIA BRANCH
(Entomological Society of British Columbia)

The 30th Annual Meeting was held on March 21st, 1931, in Vancouver, B.C.
The following papers were read:—

Presidential Address—J. W. Winson.

“Notes on the Oyster-shell Scale”—A. D. Heriot.

“Notes on *Hemisarcopeltis coccisugus*”—E. R. Buckell.

“Notes on the Woolly aphis”—A. A. Dennys.

“*Drosophila funebris* as a host of the fungus *Stigmatomyces*”—H. Leech.

“The Oviposition Habits of *Rhynchocephalus sacheni*”—J. G. Spencer.

“Notes on the Termites of British Columbia”—G. Beall.

"Chinese Insects of Commerce"—J. W. Eastham.

"Insects Affecting Holly"—W. Downes.

"Plant Quarantines and their Purpose"—H. F. Olds.

"Records of Insects Affecting Game and Wild Animals"—E. A. Bruce and E. Hearle.

"The Progress of Parasite Introduction in British Columbia"—R. Glendenning.

Five new members were elected, the membership now standing at 45.

Officers for the year 1931-1932:—Hon. President, F. Kermode; President, J. W. Winson; Vice-President (Coast), G. J. Spencer; Vice-President (Interior), E. R. Buckell; Advisory Board, Messrs. Downes, Eastham, Larnder, Lyne and Whittaker; Hon. Secretary-Treasurer, R. Glendenning; Hon. Auditor, J. W. Eastham.

The financial statement showed a credit balance of \$10.90. No. 28 of the Proceedings was distributed in November 1931.

INSECTS OF THE SEASON 1931 IN ONTARIO

By W. A. Ross, Dominion Entomological Laboratory, Vineland Station, and L. CAESAR, Ontario Agricultural College, Guelph.

Seasonal and distributional notes prepared by other officers of the Dominion Entomological Branch are incorporated in this report.

ORCHARD INSECTS

CODLING MOTH (*Carpocapsa pomonella* L.)—The codling moth has rarely, if ever, been more abundant and injurious in the warmer districts of the province, than it has been during the past two years. In many orchards this season's infestation was worse than that of 1930.

SAN JOSE SCALE (*Aspidiottus perniciosus* Comst.)—Seasonal conditions were again favourable for the San Jose scale and it increased to a very marked extent, particularly in apple orchards. Observations in the Niagara district indicate that the insect is now more abundant than it has been since 1917.

APPLE MAGGOT (*Rhagoletis pomonella* Walsh)—As shown by a survey made for the first time this fall, the apple maggot is present in many orchards in all the main fruit growing districts of the province. In Prince Edward, a decided reduction in injury was noted and in Norfolk and Elgin the infestation was quite light.

ROSY APPLE APHIDS (*Anuraphis roseus* Baker)—This was the only apple aphid which caused appreciable injury. It was responsible for considerable damage to the fruit in many orchards.

BUD MOTH (*Spilonota ocellana* D & S.)—There has been a great decrease in bud worm injury and the insect is abundant now in only a few orchards.

APPLE LEAFHOPPER (*Typhlocyba pomaria* McA.)—This hopper was sufficiently abundant in apple orchards in the Niagara district and western Ontario to cause conspicuous mottling of the foliage late in the season.

APPLE AND THORN SKELETONIZER (*Simaethis pariana* C.)—There was a severe and widespread outbreak of this species on apple trees in the Niagara peninsula and east and north of Toronto.

It is of interest to note that the insect was sufficiently abundant on young sweet cherry trees near St. Catharines to cause conspicuous injury.

EASTERN TENT CATERPILLAR (*Malacosoma americana* Fab.)—The orchard tent caterpillar was very abundant throughout Eastern Ontario in unsprayed orchards and on roadside trees.

APPLE RED BUG (*Lygidea mendax* Reuter)—In many orchards west of Toronto, including also the Georgian Bay district, there was some injury from red bug and other leaf bugs. In some Middlesex orchards, red bug injury varied from 20 per cent. to 40 per cent., particularly on the variety Greening.

APPLE LEAF ROLLER (*Archips argyrosila* Walker and *A. semiferana* Walker)—An orchard survey made by Mr. Hall showed a very marked reduction in the population of *A. argyrosila* and *A. semiferana* in Norfolk county. Elsewhere *A. argyrosila* was less troublesome than usual.

PEAR BLISTER MITE (*Eriophyes pyri* Pgst.)—There has been no general and serious outbreak of this species for some twenty years. This past season the blister mite was abundant in a nursery at Strathroy.

BLACK CHERRY APHIS (*Myzus cerasi* Fab.)—This species was again very abundant being often present even on sour cherries.

GRAY SNOUT BEETLE (*Anametis granulata* Say.)—In early May this beetle again attacked recently set peach trees in the Beamsville district.

PEAR AND CHERRY SLUG (*Eriocampiodes limacina* Retz.)—This species was common on cherry and pear trees, but the infestation on the whole was not severe.

ORIENTAL PEACH MOTH (*Laspeyresia molesta* Busck)—This insect is discussed elsewhere in this report.

SILVER MITE OF PEACH (*Phyllocoptes schlechtendali* Nal.)—“Silver leaf” was again conspicuous in Niagara peach orchards.

PEAR PSYLLA (*Psyllia pyricola* Forst.)—EUROPEAN RED MITE (*Paratetranychus pilosus* C. & F.) and PLUM CURCULIO (*Conotrachelus nenuphar* Hbst.) were present in about normal numbers.

ROSE CHAFER (*Macrodactylus subspinosus* Fab.)—Complaints of rose chafer injury were received from Cooksville, Walsingham, Lorne Park and Brantford, and from Norfolk and Middlesex counties.

GRAPE AND BUSH FRUIT INSECTS

GRAPE LEAFHOPPERS (*Erythroneura comes* Say and *E. tricincta* Fitch)—These two species once again appeared in destructive numbers in the Niagara peninsula. A very large overwintering population of hoppers went into hibernation, and the probabilities are there will be a serious outbreak next year unless steps are taken to control the insects.

EIGHT-SPOTTED FORESTER (*Alypia octomaculata* Fab.)—The larvae of this species were very abundant on grape and Virginia creepers in Middlesex county.

RED SPIDER (*Tetranychus telarius* Linn.)—In early spring it was observed that overwintering forms were very abundant on raspberries in the Niagara peninsula, but the summer infestation was about normal. In eastern Ontario it was particularly common on beans.

RASPBERRY FRUIT WORM (*Byturus unicolor* Say.)—This insect was exceptionally scarce.

RASPBERRY CANE BORER (*Oberea bimaculata* Olivier)—This insect seemed to be more abundant than at any time during the past twenty years. In some raspberry plantations 50 per cent. of the young growth was attacked by it. The insect also caused some injury to roses.

GRAPE BERRY MOTH (*Polychrosis viteana* Clem.)—Practically all the fruit in a vineyard near Beamsville was more or less ruined by the berry moth. A local outbreak of it also occurred at St. Catharines, but elsewhere the insect was of no particular consequence.

STRIPED TREE CRICKET (*Oecanthus nigricornis* F. Walk.)—This species was more injurious than usual in the Niagara peninsula. Practically all the fruiting canes in a raspberry plantation at Niagara-on-the-Lake were badly scarred by it.

CURRENT APHIDS (*Myzus ribis* L. and *Amphorophora lactucae* Kalt.)—These aphids were somewhat more numerous than usual.

VEGETABLE INSECTS

SPINACH LEAF MINER (*Pegomyia hyoscyami* Panz.)—Practically all the spinach in the Niagara district, which was not harvested by June 2 or 3, had sufficient miner injury to be useless for canning purposes.

GREENHOUSE LEAF TYER (*Phlyctaenia rubigalis* Guenée)—For the first time in many years there was a serious outbreak of this insect in the open. At Vineland, Fenwick, Burlington, Freeman, London, Leamington and several other places celery was heavily infested with it in late September and in October.

CORN EAR WORM (*Heliothis obsoleta* Fab.)—A severe and widespread outbreak of this species occurred this fall, and extended at least from Windsor to Belleville. The insect invaded greenhouses, ruined thousands of dollars worth of tomatoes, and attacked rose buds, chrysanthemums, geraniums and carnations.

SQUASH BUG (*Anasa tristis* DeG.)—This species was unusually injurious to cucurbits in south-western Ontario.

CABBAGE LOOPER (*Autographa brassicae* Riley.)—This looper was somewhat more abundant than usual on cabbage, cauliflower and turnips in most parts of the province. In Ottawa district, however, it was very scarce.

IMPORTED CABBAGE WORM (*Pieris rapae* Linn.)—There were fairly heavy infestations of cabbage worms in many parts of the province. In the Ottawa district, however, the caterpillars were quite scarce.

TOMATO WORM (*Phlegethontius quinquimaculata* Haworth)—There was an unusually heavy outbreak of horn worms in the central and south-western parts of the province.

EUROPEAN CORN BORER (*Pyrausta nubilalis* Hubn.)—Discussed elsewhere in this report.

ASPARAGUS BEETLES (*Crioceris asparagi* L. and *C. duodecimpunctata* L.)—Both species were more numerous than usual in south-western Ontario and in the Niagara district they were more abundant and destructive to asparagus than ever before in our experience.

CARROT RUST FLY (*Psila rosae* Fab.)—Scarcely any reports were received of injury to carrots from this maggot. It looks as if natural factors have once more brought the insect under control.

PEA APHID (*Illinoia pisi* Kalt.)—A severe outbreak of this aphis occurred in Elgin, Middlesex, Lambton, Kent and Essex counties.

MILLIPEDES—Great numbers of a very slender white millipede about 1½ inches long were reported by the agricultural representative for Huron county to have destroyed a whole field of beans last spring.

CUTWORMS (*Euxoa messoria*, Harr., *E. detersa*, Walk., *Sidemia devastator* Brace and other species)—Cutworms were exceptionally abundant and destructive in the Niagara peninsula and south-western regions. Among the plants attacked were raspberries, young grape vines and apples trees. In the Ottawa district cutworms were not particularly injurious but a few isolated outbreaks of *Noctua fennica* Tausch were noticed in clover fields.

CABBAGE MAGGOT (*Hylemyia brassicae* Bouche)—This insect was very abundant in south-western Ontario. In Middlesex county, fields of early turnips were completely ruined by it. In the eastern part of the province maggot injury was about normal.

CABBAGE APHIS (*Brevicoryne brassicae* L.)—Patchy but quite serious injury was caused by the cabbage aphis this spring to cabbages in the Ottawa district. The spring infestation of aphis was followed by a more serious one in late fall. In western Ontario the aphis was of very minor importance.

ZEBRA CATERPILLAR (*Ceramica picta* Harris)—This species was quite rare.

ONION MAGGOT (*Hylemyia antiqua* Meig.)—This species was less injurious than usual.

ONION THIRIPS (*Thrips tabaci* Lind.)—This thrips was of minor importance.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata* Say.)—The potato beetle was abundant throughout the province, apparently more so than last year.

POTATO FLEA BEETLE (*Epitrix cucumeris* Harr.)—This species was common on early potatoes and turnips in south-western Ontario.

STALK BORER (*Papaipema nebris* Guenee)—This insect was reported from many places and damaged chiefly beans, lilies, daisies, delphiniums and perennials.

FIELD CROP INSECTS

WIRE WORMS—Wire worms, particularly *Limonius* Sp., were more abundant and injurious throughout the whole region of south-western Ontario than for many years. Among the crops attacked were tobacco, corn, sugar-beets, potatoes, tomatoes and various other garden plants. Tobacco fields at Ottawa, and in other sections of eastern Ontario were rather badly damaged this spring. At Ottawa practically 75 per cent. of the transplants were killed. Replacing operations were carried on three times before a commercial stand was secured.

HESSIAN FLY (*Phytophaga destructor* Say.)—There are indications that there may be an outbreak of this species in the south-western part of the province next year.

WHITE GRUBS (*Lachnosterna* Spp.)—White grubs were injurious to various crops in south-western Ontario during the season. Sugar-beets and garden flowers appeared to be injured the most. Reports of serious grub injury to pastures were received from counties along the St. Lawrence river.

SOD WEBWORMS (*Crambus* Sp.) and GREEN CLOVER WORM (*Plathypena scabra* Fab.)—are discussed elsewhere in this report.

MEXICAN BEAN BEETLE (*Epilachna corrupta* Muls.)—Only one small infestation of the Mexican bean beetle was found, viz. at Walsingham, Norfolk county where it has been present for the past three years.

EUROPEAN CORN BORER (*Pyrausta nubilalis* Hubn.)—The corn borer situation is dealt with elsewhere.

CLOVER BUTTERFLY (*Eurymus philodice* Godart)—Adults of this insect were very common in alfalfa fields in south-western Ontario during the fall of the year. They were more abundant than ever before in our experience.

BEET FLEA BEETLE (*Psylliodes punctulata* Melsh.)—This insect seriously injured several fields of sugar-beets in south-western Ontario just after the plants came through the ground. The beetle is fairly well distributed over the sugar-beet growing areas.

SEED CORN MAGGOT (*Hylemyia cilicrura* Rond.)—This insect was fairly abundant and injurious in a large tobacco field near Kingsville. Minor infestations were also noted on lima beans and corn.

GRASSHOPPERS—Grasshoppers, principally *Melanotus femur-rubrum* De Geer, increased rapidly during the summer and were abundant on waste lands and old pastures in most parts of the province. In Prince Edward county the hoppers apparently were held in check chiefly by the praying mantis, *Mantis religiosa* L., which could be collected by the hundreds in many grass fields and along the roadside. The mantis was also noted as being common in the southern part of Hastings county.

CLOVER LEAF WEEVIL (*Hypera punctata* Fab.)—Rather severe weevil injury to clover was noticed this spring in the vicinity of Ottawa. The damage was patchy but attacked plants were usually practically defoliated.

TURNIP MAGGOT—A maggot very closely related to the cabbage maggot, but apparently a little larger, has caused severe injury to many fields of turnips by disfiguring the surface and making them unfit for export. We have not yet had a chance to rear the adult and determine whether it is the cabbage maggot or some new species. A turnip buyer and exporter says this injury has been increasing each year for several years and, if it continues, will put an end to all export of turnips to the United States.

FOREST AND SHADE TREE INSECTS

EUROPEAN PINE SHOOT MOTH (*Rhyacionia buoliana* Schiff.)—The European pine shoot moth was very prevalent in Welland county, in some cases reappearing in ornamental plantings which had been free for two years. Injury to pine plantations around summer homes along the north shore of Lake Erie from Fort Erie to Port Colborne, was very apparent and from 25 to 90 per cent. of the Scotch Jack, and Austrian pines in this area were found to be quite seriously infested. The infestation in the area between Fort Erie and Port Colborne was discovered for the first time this spring.

PINE BUD MOTH (*Exoteleia dodecella* L.)—During the month of May, larvae of this pest caused considerable damage to the small buds of Scotch and Mugho pines in nurseries in the Fonthill-Ridgeville district.

This European insect was first discovered at Fonthill and Ridgeville in June 1928 and was at that time new to North America. While the infestation was somewhat heavier at Ridgeville this year and while the moth now occurs in

the Niagara Falls district, there has been no very marked increase or spread since 1928.

WHITE PINE WEEVIL (*Pissodes strobi* Peck.)—About the middle of July a considerable number of young white pines in the forestry station at St. Williams were found to have been injured by the white pine weevil, and the same pest was frequently found injuring twigs of the larger roadside white pines throughout Norfolk county.

SPRUCE BUDWORM (*Cacoecia fumiferana* Clem.)—This species was abundant in the Belleville district during the early summer, but practically all the larvae were devoured by birds.

LARCH SAWFLY (*Lygaeonematus erichsoni* Hartig)—This sawfly was present in practically all larch stands throughout southern Ontario, being more abundant in the drier stands of larch where, in some cases, almost total stripping occurred.

LARCH CASE BEARER (*Haploptilia laricella* Hb.)—The larch case bearer was unusually abundant.

BLACK WALNUT CATERPILLAR (*Datana integerrima* G. R.)—This caterpillar was again present in outbreak form and completely or partially defoliated many walnut and butternut trees from Niagara to Windsor.

BIRCH LEAF SKELETONIZER (*Bucculatrix canadensisella* Chamb.)—This insect was abundant on and caused conspicuous injury to birch trees in the north and also in most if not all parts of southern Ontario.

THE FALL WEBWORM (*Hyphantria textor* Harris.)—The fall webworm was more abundant throughout southern Ontario than it has been for many years.

OAK CATERPILLAR (*Anisota senatoria* S. & A.)—This species was noted on roadside oaks in eastern Ontario and in many cases the trees were totally defoliated by it.

BLADDER MAPLE GALL (*Phyllocoptes quadripes* Shimer)—Bladder galls were quite abundant on maple trees this year.

COTTONY MAPLE SCALE (*Pulvinaria innumerabilis* Rathv.)—This scale was fairly common on maple in Middlesex county.

Serica sericea Ill.—These leaf eating beetles were more numerous than usual and partly defoliated walnut trees in western Ontario.

LESSER CARPENTER WORM (*Prionoxystus macmurtrei* Guer.-Men.)—What is probably this species severely injured oak trees on the Indian reservation at Walpole Island. Observations on oak groves indicate that the insect is prevalent throughout the district.

OYSTER-SHELL SCALE (*Lepidosaphes ulmi* L.)—An exceptionally heavy infestation of this pest was noticed on young roadside maple trees in the Fonthill district.

ELM LEAF MINER (*Kaliofenusula ulmi* Sund.)—This species, which was noted as being abundant between Cobourg and Port Hope in 1930, was prevalent on European elms from Guelph-Hamilton eastward to Montreal. So far as observed, American elms were not attacked.

WOOLLY ELM APHIS (*Eriosoma americana* Riley)—In the Ottawa district this species was very abundant on elms in the early part of summer.

POPLAR VAGABOND GALL. (*Mordvilkaja vagabunda* Walsh)—A considerable number of the aspen trees on Long Point, Norfolk county were found in mid-summer to be almost covered and made very unsightly by the old and new galls of this plant-louse.

COARSE WRITING BARK-BEETLE (*Ips calligraphus* Germ.)—This bark-beetle occurred in outbreak form on white and red pines at Niagara Falls, Queenston, Niagara-on-the-Lake, Freeman, Burlington and St. Williams. Toward the latter part of the summer, countless numbers of beetles were found infesting and apparently killing numbers of large white pines which, although possibly weakened by last year's drought and this summer's intense heat, appeared in the early stages of attack to be otherwise healthy and reasonably vigorous in growth.

BRONZE BIRCH BORER (*Agrilus anxius* Gory)—About 50 per cent. of the ornamental white or silver birch trees, especially the cut-leafed varieties, in Stamford township immediately west of Niagara Falls, are being seriously injured and in some cases killed by this beetle.

YELLOW-SPOTTED WILLOW SLUG (*Pteronidea ventralis* Say.)—In early June this insect was present in sufficiently large numbers on weeping-willow nursery stock at Jordan to necessitate spraying with an arsenical.

INSECTS INJURIOUS TO FLOWERS AND ORNAMENTALS

GLADIOLUS THIRIPS (*Taeniothrips gladioli* M. & S.)—This thrips in Ontario is dealt with elsewhere.

GARDEN FLEA HOPPER (*Halticus bractatus* Say.)—Zinnias and other garden plants were injured by this insect in the vicinity of Rondeau Provincial Park.

HONEYSUCKLE SAWFLY (*Abia inflata* Nort.)—Several honeysuckle bushes were partially defoliated by the larvae of these sawflies at a dwelling in the town of Essex. This is the first year that we have any record of injury by this insect.

VIOLET SAWFLY (*Emphytus candensis* Ky.)—The larvae of this sawfly were abundant in practically all pansy beds in the vicinity of Ottawa and did very serious injury.

TARNISHED PLANT BUG (*Lygus pratensis* L.)—This species was very numerous in the Ottawa district. Dahlias, asters and gladiolus suffered particularly from its predations and the dahlia crop was practically a total failure. Quite severe injury to fields of potatoes was noticed. In the western part of the province the insect was not unusually abundant.

COLUMBINE BORER (*Papaipema purpurifascia* G. & F.)—This species caused considerable injury especially at Exeter, Thornhill and Owen Sound.

BLACK VINE WEEVIL (*Brachyrhinus sulcatus* Fab.)—The outbreak of this insect is discussed elsewhere in this report.

THREE LINED POTATO BEETLE (*Lema trilineata* Ol.)—This beetle was present in Niagara Falls, feeding on the foliage and seed pods of Chinese lantern and other herbaceous plants.

BLACK BLISTER BEETLE (*Epicauta pennsylvanica* DeG.)—Reports were received from Niagara Falls and St. Catharines of damage to aster plants by this beetle. An especially severe infestation occurred in the trial flower beds in Victoria Park, Niagara Falls.

STORED PRODUCT AND HOUSEHOLD INSECTS

SAW-TOOTHED GRAIN BEETLE (*Oryzaephilus surinamensis* L.); GRANARY WEEVIL (*Calendra granaria* L.) and CONFUSED FLOUR BEETLE (*Tribolium confusum* Jacq. Duv.)—Granary insects are very prevalent and injurious to wheat stored in farmers' granaries this year. The infestation is wide-spread, extending at least from Essex county to the Niagara district. In many cases the insects are abundant enough to cause the grain to heat.

PSOCIDS—These insects are very numerous in wheat and oats stored in farmers' granaries. They are often mistaken for injurious grain insects.

HOUSEFLY (*Musca domestica* L.)—House flies were excessively abundant this fall and caused more than the usual amount of annoyance in houses and offices.

FLEAS (*Ctenocephalus canis* Curtis)—On a farm in Dover township, Kent county, fleas infested the barnyard and buildings, and were very troublesome to the residents and visitors. The fleas were so numerous that when one stepped into the buildings five or six fleas could be collected on a trouser leg. According to the farmer, cats and dogs had not been around the farm for several years, but the fleas had been present for a number of years and this year were more abundant than ever. Fleas were also troublesome in an office building at Chatham and were reported as being more prevalent than usual in Belleville.

HOUSE MOSQUITO (*Culex pipiens* L.)—This species was very common and troublesome in the Niagara Falls-Stamford district throughout September and early October.

STABLE FLY (*Stomoxys calcitrans* L.)—This insect was exceptionally numerous and annoying along the shores of Lake Erie.

SILVER FISH (*Lepisma* Sp.)—Many inquiries were received about methods of controlling silver fish.

WEBBING CLOTHES MOTH (*Tineola bisselliella* Rum.)—This insect was very prevalent in houses in the city of Chatham, and caused much damage to clothing, etc. Clothes moths were also reported as being more troublesome than usual in Belleville.

INSECTS OF THE SEASON 1931 IN NOVA SCOTIA

F. C. GILLIATT

Dominion Entomological Laboratory, Annapolis Royal, N.S.

During the year 1931 there was no widespread outbreak of any species of insect to cause serious losses to the fruit grower of the Annapolis Valley.

GREEN APPLE APHID (*Aphis pomi* DeG.)—There was no injury from this insect during 1931.

ROSY APHID (*Anuraphis roseus* Baker.)—There was an infestation involving the entire fruit growing area and the nymphs persisted upon fruit trees to a later date than usual, many orchards showed evidence of the damage done by the presence of gnarled fruit in the fall.

GREEN APPLE BUG (*Lygus communis* Knight)—The green apple bug is still a major orchard pest and generally was somewhat more in evidence than in 1930.

EYE-SPOTTED BUDMOTH (*Spilonota ocellana* D. & S.); GREEN BUD WORM (*Argyroploce variegana* Hbn.); OBLIQUE BANDED LEAF ROLLER (*Cacoecia rosaceana* Harris); and the LESSER BUDMOTH (*Recurvaria nanella* Hbn.)—There has been a further reduction in numbers of these various budmoths in Annapolis Valley orchards; at the present time these insects are minor orchard pests.

CIGAR CASE BEARER (*Haploptilia fletcherella* Fern.)—The infestation has been less marked than during the previous year and no serious injury resulted.

CODLING MOTH (*Carpocapsa pomonella* L.)—This insect probably caused somewhat more wormy fruit than in the average year.

EUROPEAN APPLE SUCKER (*Psyllia mali* Schmid.)—There were very few severe infestations of the apple sucker during 1931.

TENT CATERPILLAR (*Malacosoma americana* Fab.)—The prevalence of tent caterpillars in 1930 suggested the possibility of greater infestations for 1931; this however, did not materialize. Many tents appeared upon the trees early in the spring but for the most part colonies were small and the caterpillars dwindled rapidly in numbers.

GREY-BANDED LEAF ROLLER (*Eulia mariana* Fern.)—There has been a further extension of the infested area with additional increases of this leaf roller in some sod mulch orchards. In the Lakeville and Morristown districts a conservative estimate in a few orchards was 20 to 25 per cent. of the fruit damaged.

EUROPEAN RED MITE (*Paratetranychus pilosus* C. & F.)—During the first half of the season there was a decided decrease of the red mite. Commencing in August increases were noted in many orchards, such increases continuing throughout the early fall. There will be a considerable number of orchards scattered throughout the Annapolis Valley with slight to moderate infestations of winter eggs this fall; but from observations made only few severely infested orchards.

DUSKY LEAF ROLLER (*Amorbia humerosana* Clem.)—In the Annapolis district this leaf roller is on the increase particularly at Roundhill and Moschelle. In some varieties of fruit there was 25 per cent. showing side injury.

PLUM CURCULIO (*Conotrachelus nenuphar* Hbst.)—There was about the average degree of infestation among plums and cherries in the western part of the valley.

TUSSOCK MOTHS (Rusty and White Marked)—No reports were received of damage by these insects.

THE PALE APPLE LEAF HOPPER (*Typhlocyba pomaria* McA.)—Leaf hoppers were prevalent and widespread in Annapolis Valley orchards during 1931.

APPLE AND THORN SKELETONIZER (*Simaethis pariana* Cl.)—Specimens were received from a few outlying districts. In the fruit area the insect was not conspicuous and no defoliation occurred even on neglected trees.

FALL WEB WORM (*Hyphantria cunea* Dru.)—A pronounced outbreak of this insect occurred in all parts of the province, including the forested areas. It was not unusual for small apple trees to be entirely enveloped with the webs of this insect.

PEAR SLUG (*Eriocampoides limacina* Retz.)—There was some skeletonizing of pear and cherry trees from the first brood, chiefly in the Annapolis and Deep Brook districts. There was a decided decrease later and very few second brood slugs appeared.

CLOVER OR BROWN MITE (*Byrobia praetiosa* Kock.)—This mite has decreased greatly in numbers and was only observed on a few occasions during the past summer.

CANKER WORMS (*Alsophila pometaria* Harr.)—The canker worms caused considerable defoliation, more particularly in the western part of the Annapolis valley.

COCKCHAFER (*Hoplia trifasciata* Say)—The adults of this species were observed feeding in large numbers upon apple blossoms at Tupperville. All observed were males.

SCURFY SCALE (*Chionaspis furfura* Fitch)—In a few instances this scale infested the surface of apples causing a red or purplish depressed area.

FIELD AND GARDEN INSECTS

CARROT RUST FLY (*Psila rosae* Fab.)—Early in the spring there was probably less than the normal numbers of this insect. From the number of infested roots at harvest time some increase of the second brood has occurred.

CORN EAR WORM (*Heliothis obsoleta* Fab.)—This insect was generally disseminated over Nova Scotia and some rather severe infestations occurred.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata* Say.)—There was about the usual potato beetle infestation.

TARNISHED PLANT BUG (*Lygus pratensis* L.)—This bug was observed in small numbers but no severe infestation.

CUCUMBER BEETLE (*Diabrotica vittata* Fab.)—Cucumber beetles were particularly numerous and caused considerable damage in gardens during the past summer.

ZEBRA CATERPILLAR (*Ceramica picta* Harr.)—No reports were received of any damage from this insect.

EUROPEAN CORN BORER (*Pyrausta nubilalis* Hbn.)—Only a few specimens were found as result of the scouting during 1931.

POTATO FLEA BEETLE (*Epitrix cucumeris* Harr.)—There appeared to be somewhat less than the normal numbers of this beetle, though extending later in the season than usual.

CUTWORMS (*Various species*)—A decided increase of garden cutworms has occurred. The infestation was widespread in Nova Scotia with much damage to gardens, and in some sections of Cumberland Co. to grain.

IMPORTED CABBAGE WORM (*Pieris rapae* L.)—There appeared to be somewhat less than the normal numbers of this insect.

POTATO STEM BORER (*Hydroecia micacea* Esp.)—Fewer reports were received of injury from this borer.

GARDEN SLUGS (*Limax* Sp.)—Although more in evidence than the previous year, slugs were not particularly troublesome.

CHINCH BUG (*Blissus leucopterus* Say.)—There were some severe infestations of chinch bug in various parts of Nova Scotia, perhaps more particularly in lawns at Halifax. It was noticed in Annapolis, Kings, Hants, Halifax, Lunenburg and Queens counties.

CABBAGE MAGGOT (*Pegomyia brassicae* Bouche)—There was considerable damage from this maggot, particularly in Cumberland County.

CRICKETS were very numerous everywhere during the later part of the summer and fall.

GRASSHOPPERS—Some severe infestations of hoppers occurred particularly in Cumberland County and on the marshes near Wolfville.

FOREST AND SHADE TREE INSECTS

BIRCH LEAF SKELETONIZER (*Bucculatrix canadensisella* Cham.)—This forest insect was not so numerous as in 1930 although many birch groves were considerably defoliated in many parts of the province.

LARCH CASE BEARER (*Haploptilia laricella* Hbn.)—This insect was less numerous than in 1930, the infestations being confined to small patches in the groves.

BLACK HEADED BUDMOTH (*Peronea variana* Fern.)—The outbreak of this insect in the forests of Cape Breton Island is now definitely past, the insect being present in negligible numbers during 1931.

BALSAM BARK LOUSE (*Dreyfusia piceae* Ratz.)—This insect is the most important species now active in Nova Scotia forests.

BEECH COCCUS (*Cryptococcus fagi* Baer.)—Dying of beech following the attacks of this insect continues and practically the whole province is infested.

HEMLOCK BORER (*Melanophila fulvoguttata* Hart.)—The infestation in the foliage at Lake Rossignol, which it was thought might spread into the hemlock stands of the region, has been reduced by woodpeckers, parasites and other natural causes. The green timber is not attacked to any extent.

HEMLOCK LOOPER (*Elloptia fiscellaria* Guen.)—This caterpillar, often a destructive pest of balsam, was common again this year but did no important damage.

EASTERN SPRUCE BARK BEETLE (*Dendroctonus piceaperda* Hopk.)—Many of the larger spruce stands have been infested during the last two or three years, and patches of timber killed varying from one to fifteen acres.

A green colored larva, about three-quarters of an inch in length when full grown, and with leaf rolling habits, severely infested birch trees in Digby, Annapolis and Kings County. Many birch groves were completely defoliated during August and September. Feeding was also observed on oak, maple and beech, but to a much less extent. Attempts to have this species identified from the larvae have not been successful.

INSECTS OF THE SEASON 1931 IN NEW BRUNSWICK

R. P. GORHAM, G. P. WALKER, L. J. SIMPSON, Dominion Entomological
Laboratory, Fredericton, N.B.

FIELD CROP AND GARDEN INSECTS

In a general way, field crop and garden insects were more numerous and troublesome in 1931 than during the three preceding years. Notwithstanding this abundance, few crops, with the exception of the raspberry, suffered widespread or serious damage.

APHIDS—Aphids of different kinds were abundant and injurious to field crops and ornamentals during the early summer.

BLACK VINE WEEVIL (*Brachyrhinus sulcatus* Fab.)—The black vine weevil in the southern part of Kings county caused some loss through destruction of plants just before harvest.

BRONZE CUTWORM (*Nephelodes emmedonia* Cram.)—The bronze cutworm caused no injury on the Tantramar dykelands in 1931, the outbreak lasting three years having definitely ended.

CLOVER INSECTS.—The heads and foliage of red clover were freely attacked by *Phytonomus meles* Fab., *Tychius picirostris* Fab., *Phytonomus nigrirostris* Fab., *Sitona hispidulus* Fab., and *Laspeyresia interstinctana* Clem., which in some fields caused severe injury.

CORN EAR WORM (*Heliothis obsoletus* Fab.)—The corn ear worm was very troublesome in sweet corn.

EUROPEAN CORN BORER (*Pyrausta nubilalis* Hbn.)—The European corn borer was less numerous than in other years, being located on three farms only with a total of twenty-three stalks affected.

GRASSHOPPERS.—Grasshoppers were numerous on low lands and caused injury to grass, grain and turnips near dykes.

IRIS BORER (*Macronoctua onusta* Grote)—Iris borers were found in large numbers in wild iris roots at Mud Lake, York county, in July. A small bog, miles in the forest, supported many plants—all infested. This is the second location found for this insect in the province.

PAINTED LADY (*Vanessa cardui* L.)—A flight of this migratory butterfly reached New Brunswick in June, the first in several years. Larvae were abundant on thistles in all parts of the province in July and again in September. The larvae attacked the foliage of hollyhock and sunflower as well as thistle.

PEACOCK FLY (*Straussia longipennis* Wied.)—The peacock fly is increasing in abundance at Fredericton. Ornamental sunflower stems were so badly injured that many broke down with the wind.

RASPBERRY FRUIT WORM (*Byturus unicolor* Say)—Beetles of the raspberry fruit worm appeared in very large numbers, feeding upon the buds and opening blossoms of the raspberry and blackberry, both cultivated and wild, with the result that practically no wild fruit developed and the crop on cultivated plantations was seriously reduced.

SLUGS.—Slugs were numerous and injurious to ornamentals and potatoes in different parts of the province.

STRAWBERRY WEEVIL (*Anthonomus signatus* Say)—The strawberry weevil, usually only seen in a few localities, was noticeably abundant in many places attacking strawberries and raspberries. It was common on wild raspberries at Fredericton and on cultivated raspberries at Douglas. On one farm at Macnaquac, 20 per cent. of the buds of cultivated blackberry were cut. This was the first instance seen of injury to the blackberry.

STRIPED CUCUMBER BEETLE (*Diabrotica vittata* Say)—The striped cucumber beetle, after two years of scarcity, was very abundant and troublesome in 1931.

TARNISHED PLANT BUG (*Lygus pratensis* L.)—The tarnished plant bug was more than usually abundant and injurious to ornamentals.

FOREST AND SHADE TREE INSECTS

BIRCH LEAF-MINING SAWFLY (*Phyllotoma nemorata* Fallen) and BIRCH LEAF SKELETONIZER (*Bucculatrix canadensisella* Chamb.) caused severe injury to the foliage of birch in all counties of the province.

ACROBASIS BETULELLA Hulst—Small birch trees in an old cutting were found defoliated by larvae of *Acrobasis betulella* on July 1, with cocoons on the branches.

LARCH CASE BEARER (*Haploptilia laricella* Hb.)—was not quite so general in distribution as in previous years. Severe injury to foliage occurred in places in Carleton, York and Queens counties but many areas were but slightly affected.

LARCH SAWFLY (*Nematus erichsoni* Hartig)—This insect showed slight increase in abundance following the marked scarcity in 1930.

ARBOR-VITAE LEAF MINER (*Argyresthia thuiella* Pack.)—Only slight injury was caused by the leaf miner in 1931.

WHITE PINE WEEVIL (*Pissodes strobi* Peck.)—Was present in the usual numbers.

PINE BARK APHID (*Chermes pinicorticis* Fitch) was abundant on red and white pines, particularly in nurseries.

PINE PITCH MOTH (*Rhyacionia (Evetria) comstockiana* Fern.) was almost completely absent from Jack pine stands where it was abundant in 1930.

SATIN MOTH (*Stilpnota salicis* L.) Severe stripping of foliage occurred in Moncton in late June. The whole city was infested and parts of the suburb of Lewisville, as well as Sussex, Kings county, and Elgin, Albert county. Larvae fed upon the foliage of *Populus deltoides*, *P. alba* and *Salix alba*.

BALSAM BARK LOUSE (*Dreyfusia piceae* Ratz.) has been increasing in numbers for a good many years. The greater part of Westmorland, Albert, Kings, St. John and Charlotte counties is infested. Smaller centres occur in the southern part of Queens and Sunbury counties and as far north as Fredericton, where trees are being killed. The remainder of the province appears to be free from the insect. Nova Scotia is completely infested.

BEECH COCCUS (*Cryptococcus fagi* Baeri.)—It is interesting to note that this insect covers about the same ground as the preceding species. It has been found as far west as St. Andrews and as far north as Jemseg. Many beech trees are already dying in Westmorland and Albert counties.

Both of these insects appear to be gradually spreading through the province.

FALL CANKER WORM (*Alsophila pometaria* Harr.)—The larvae were numerous, and injurious. They were less noticeable under forest conditions than in the towns.

WHITE-MARKED TUSSOCK MOTH (*Hemerocampa leucostigma* A. & S.)—The larvae of this insect were less abundant than in 1930.

FOREST TENT CATERPILLAR (*Malacosoma disstria* Hb.)—This insect has not been seen for several years.

FALL WEBWORM (*Hyphantria cunea* Drury)—The webs of this insect were very abundant on elm, maple, alder and willow in the counties of Westmorland, Albert, Kings and Queens counties; less so in the other counties of the province.

EASTERN TENT CATERPILLAR (*Malacosoma americana* Fab.)—Webs of this insect were more numerous than in 1930 in the counties of York, Carleton, Charlotte, St. John, Kings, Queens and Sunbury.

FRUIT INSECTS

APPLE MAGGOT (*Rhagoletis pomonella* Walsh)—This insect has increased generally throughout the province. Exceptionally heavy outbreaks were reported from Carleton county and noted in Sunbury and York counties.

APPLE AND THORN SKELETONIZER (*Simaethis pariana* Cl.)—The apple and thorn leaf skeletonizer caused defoliation of unsprayed trees in parts of Kings county and was noticeably abundant in York and Charlotte counties.

BUD MOTHS—These insects increased materially in the commercial orchards, especially in the St. John river valley and Keswick Ridge sections.

BUFFALO TREE HOPPER (*Ceresa bubalus* Fab.)—Tree hopper punctures were numerous on the branches of young trees in York county in spring and very large numbers of nymphs hatched out.

CIGAR CASE BEARER (*Haploptilia fletcherella* Fern.) and PISTOL CASE BEARER (*H. malivorella* Riley)—One orchard near Penobsquis, Kings county, was defoliated by case bearers, the cigar case bearer being more abundant than the pistol case bearer. In the French lake section of Sunbury county the cigar case bearer has noticeably decreased.

CURCULIOS (presumably both apple and plum)—Curculios have apparently increased materially in the Maugerville and French lake sections of Sunbury county.

EUROPEAN RED MITE (*Paratetranychus pilosus* C. & F.)—European red mite decreased during the summer months but increased again quite extensively in sections where it had been abundant in 1930.

GREEN APPLE BUG (*Lygus communis* var. *novascotiensis* Knight)—An apparently fairly new outbreak of this insect was noted at Keswick ridge, York county.

OYSTER-SHELL SCALE (*Lepidosaphes ulmi* L.)—The oyster-shell scale is in outbreak abundance and injurious to young orchard trees, and to unsprayed old orchards.

PEAR LEAF BLISTER MITE (*Eriophyes pyri* Pagnst.)—A few apple and pear trees were heavily infested with this pest at Ingleside, Kings county.

PEAR SLUG (*Eriocampoides limacina* Retz.)—Pear slug severely injured a number of cherry and plum trees at French lake, Sunbury county, and Ingleside, Kings county.

RED-HUMPED CATERPILLAR (*Schizura concinna* S. & A.)—The red-humped caterpillar was present in about the usual numbers.

INSECTS OF THE SEASON 1931 IN SOUTHERN QUEBEC

C. E. PETCH, Hemmingford, Que.

OYSTER-SHELL SCALE (*L. ulmi* L.)—This insect was very prevalent in the Clarenceville district on wild and unsprayed apple trees and in addition several reports of serious injury were received in correspondence.

RASPBERRY CANE BORER (*Oberea bimaculata* Oliv.)—The injury was very conspicuous in the Clarenceville district this year. About the time when the raspberries and blackberries were fruiting as high as 30 per cent. of the canes began to wither and die. Only slight injury was noted at other points.

GREEN APPLE APHIS (*Aphis pomi* DeG.)—Without showing apparent increase over previous years this insect appeared in considerable numbers on opening of apple buds.

APPLE MAGGOT (*Rhagoletis pomonella* Walsh)—Apple maggot flies were present in considerable numbers but a provincial control campaign resulted in small infestations in the commercial orchards.

APPLE CURCULIO (*Tachypterus quadrigibbus* Say)—The apple curculio has increased considerably in the fruit growing districts south of Montreal. It was especially troublesome in Abbotsford and St. Hilaire this year.

NEW YORK WEEVIL (*Ithycerus noveborascencis* Forster)—This insect was found for the first time in large numbers in Quebec. It seriously injured the leaf spurs in a young orchard at St. Hilaire.

LEAF ROLLERS (Several species)—Leaf rollers were quite injurious to apple foliage in the fruit areas this year. There was a vast increase in their numbers over previous years and a large number of leaves were infested especially in young orchards.

CHERRY CASE-BEARER (*Haploptilia pruniella* Clem.)—It was interesting to observe that case-bearers, which have been so injurious to apple foliage at Ville La Salle and vicinity during the past several years, were reduced very considerably this past season. This reduction was due to the efficient work of parasites and sleet storms.

MAPLE LEAF CUTTER (*Paraclemensia acerifoliella* Fitch)—This insect was not conspicuous in Southern Quebec this year, which means a very heavy reduction since 1930.

TENT CATERPILLARS (*Malacosoma* spp.)—Tent caterpillars were not troublesome this season. In places where these were present in considerable numbers in 1929 and 1930 very few tents were seen this year. There has been no important increase in the province since 1914.

CARPENTER WORM (*Prionoxystus robiniae* Peck)—This wood borer is especially injurious to soft maple in the districts of Montreal, Sorel, Three Rivers and Huntingdon. It was also observed that a few Negundo maples were injured at St. Martin, Que.

EUROPEAN FRUIT LECANIUM (*Lecanium corni* Bouche)—Twigs of elm and maple were reported from the Eastern Townships and Montreal district to be seriously injured by this insect. A few scales were found on apple but most of the damage was done to shade trees.

FALL WEBWORM (*Hyphantria cunea* Drury)—The increase was very marked over 1930. Tents of this caterpillar were found almost everywhere in Quebec.

LARCH CASE BEARER (*Haploptilia laricella* Hbn.)—This pest seems to have increased steadily in the Hemmingford district. Nearly 100 per cent. of the larch were heavily infested with this insect in the spring and this was repeated later in the season. The injury was also very conspicuous at Dunham, Bedford, Pike River, St. John's, Lacolle and Henrysburg. It was also observed in considerable numbers in the Eastern Townships along the highways.

LARCH SAWFLY (*Lygaeonematus erichsoni* Hartig)—The injury of the larch sawfly was very conspicuous over the same districts as the larch case bearer

caused damage. As compared with last year there was a reduction of injury, although the infestation this year was severe and the damage quite important. Defoliation to the extent of 75 per cent. was commonly observed.

WIREWORMS (Several species)—Wireworms were severe on tobacco in the counties of L'Assomption, Montcalm, Berthier and Joliette according to a report received from the Experimental Station at L'Assomption. Over 50 per cent. of the tobacco plants were killed and thousands had to be reset. These insects also caused some damage to tobacco and other crops in the Yamaska valley.

ASPARAGUS BEETLE (*Crioceris 12-punctata* L.)—This species was quite abundant in the asparagus fields at Abbotsford, Que. The beetles were numerous enough to cause damage of some importance.

DARKSIDED CUTWORM (*Euxoa messoria* Harr.)—This species was the most prevalent cutworm in the Clarenceville district this year. It injured the seedlings of many garden crops, including beets, lettuce and carrots.

WHITE GRUBS (*Phyllophaga anxia* Lec.)—White grubs were very numerous in the Clarenceville district this year but owing to these being first-year grubs they caused only occasional damage to untreated sod. In the Oka-St. Jerome section, second-year grubs caused severe injury to strawberry plants, potatoes, corn and timothy sod. Injury to susceptible crops will likely be severe during 1932 over southern Quebec where no control measures have been employed.

MICROPHTHALMA WHITE GRUB PARASITE (*M. michiganensis* Towns.)—The microphthalma parasite, one of the most important white grub natural enemies had a minor flight which was of greater importance than at first expected. This parasite killed a large proportion of the local second-year white grubs.

CUCUMBER BEETLE (*Diabrotica vittata* Fab.)—The striped cucumber beetle was very common and injurious over the southern Quebec zone. In many cases a complete loss of the first seeding occurred in gardens.

CABBAGE MAGGOT (*Hylemyia brassicae* Bouché)—The cabbage maggot was very injurious to cabbage, Brussel sprouts, radish and cauliflower over southern Quebec. In a number of cases entire stands of garden radish were spoiled.

FIELD CRICKET (*Gryllus assimilis* Fab.)—The field cricket was very common over southern Quebec. They were outnumbered in the Clarenceville section by other species of orthoptera but were decidedly on the increase as compared with the several previous years.

GRASSHOPPERS—(Several species)—More abundant than in late years, grasshoppers of many species were found everywhere in southern Quebec. They were reported to be very injurious to apple in Missisquoi and Huntingdon counties. The red-legged locust (*M. femur-rubrum* DeG.), assumed outbreak form in several localities. Damage to timothy and clover foliage was general and injury to oats was often important. The two-striped locust (*M. bivittatus* Say) was much more common than previously observed over southern Quebec but the damage was not so important as that caused to crops by the red-legged locust. The sordid locust (*Encoptolophus sordidus* Burm.) appeared in large numbers in timothy fields and pastures throughout the Clarenceville district this year. It became more abundant as the season progressed until at the latter part of August it became almost as common as the red-legged locust.

INSECTS OF THE SEASON 1931 IN QUEBEC DISTRICT

G. MAHEUX,

Quebec Department of Agriculture, Quebec.

CUTWORMS (Various species)—Cutworms were not quite so injurious as last year; peculiar damage reported at Giffard, near Quebec, where gladioli suffered to the extent of 40%.

WIREWORMS—Much more troublesome than usual throughout the province. A very severe outbreak occurred at St. Joachim, 25 miles east of Quebec, where a field of oats was completely ruined by wireworms present in the soil at the rate of about 22 by squarefoot.

WHITE GRUBS (*Phyllophaga* spp.)—Heavy flight in Montreal district and Eastern townships.

GRASSHOPPERS—Not seen to any appreciable extent in the ordinary sandy sections but in the south-western of the province where they are seldom seen. Nursery stock, apple trees, were completely defoliated in some localities.

APHIS—Undoubtedly, as the whole, the most widely distributed and injurious insects of the season. Nearly all sorts of cultivated plants were reported as affected by aphis, such as apple trees, ornamentals, carrots, green-peas, etc. Around St. John, peas grown for canning purposes were injured for 40% to 75%. Experiments for control have been started this year with very satisfactory results.

Nothing very outstanding to be noted regarding orchard pests, excepted that weevils seem to become year after year more serious and widespread pests. In some localities apple maggot is also very troublesome. This year we had more leaf-eating caterpillars than in previous years: *Malacosoma disstria*, (Quebec); *Datana ministra*, (Montreal); *Schizeura concinna* (Montreal).

STRAWBERRIES—The strawberry weevil caused damages estimated to 25%—75% around Quebec. This pest is rapidly increasing and coupled with the leaf-rollers, the white grubs and the thrips (*Euthrips tritici*) makes the growing of strawberries less and less profitable. A sort of spray service is being organized for the benefit of growers who are quite numerous in Quebec district.

RASPBERRIES—The cane-borer is spreading and was more injurious than the year before in many localities.

CURRENTS—Badly affected with aphis; imported currant worms, normal.

FLEA-BEETLES—Quite numerous and wide spread. Severe losses in young cabbage and cauliflower seedlings. Also injurious to potatoes in early season.

Cabbage-maggots, Onion maggot, green cabbage worms, striped cucumber beetles about normal. We had a few cases of beans and onions suffering 10% damage from cut-worms.

APHIS—About 25% damage on roses and dahlias.

THRIPS—Thrips were very injurious to gladioli around Montreal, (40% to 90% injury) and to roses around Quebec (50% injury).

TARNISHED PLANT BUGS—About 25% damage on dahlias and other plants.

INSECTS OF THE SEASON 1931 IN MANITOBA

A. V. MITCHENER

University of Manitoba, Winnipeg, and

NORMAN CRIDDLE

Dominion Entomological Laboratory, Treesbank

Numerous species attained injurious proportions, some of which are here recorded for the first time or for the first time in many years in Manitoba. Altogether insect activity reached greater intensity than at any time during the last decade.

FIELD CROP INSECTS

FIELD CRICKET (*Gryllus assimilis* Fab.)—Although they did not do much evident damage they occurred in great numbers over much of the area infested with grasshoppers. In a few cases they proved very troublesome within houses.

GRASSHOPPERS—There was a very marked increase in the numbers of grasshoppers in 1931 particularly in the eastern agricultural area centering on the Red River Valley where grain crops were badly injured. By far the most important species was the clear-winged grasshopper (*Camnula pellucida* Scudd.) which outnumbered all other species combined. The two-striped grasshopper (*Melanoplus bivittatus* Say), the lesser migratory grasshopper (*Melanoplus mexicanus mexicanus* Saussure) and the red-legged grasshopper (*Melanoplus femur-rubrum* De G.) followed in importance in the order named. The period for oviposition was very favorable which resulted in many eggs being laid. The probabilities greatly favor grasshopper injury to crops in 1932.

WESTERN CHINCH BUG (*Blissus occiduus* Barber).—The appearance of this insect in great numbers locally in the vicinity of Sperling, Brunkild and Miami constitutes a record for Manitoba. A limited acreage of spring wheat, brome grass pasture and barley was almost completely destroyed.

ALFALFA CATERPILLAR (*Eurytus eurytheme* Boisd.)—At Bird's Hill, alfalfa on high land was severely attacked during the first week of July. Radiators of cars coming into Winnipeg from the south were covered with adults over a long period of time.

THISTLE BUTTERFLY (*Vanessa cardui* L.)—Canadian thistles were heavily attacked by these caterpillars. They were evidently very widespread, abundant and entirely beneficial.

ARMYWORM (*Cirphis unipuncta* Haw.)—Severe damage was done to headed oats during the latter part of July and the first three or four days of August on several farms approximately ten or twelve miles northwest of Lac du Bonnet. On August 6 practically all were in the pupal stage.

CUTWORMS—Most complaints came from the Red River Valley where considerable damage was done both to field and garden crops. The red-backed cutworm (*Euxoa ochrogaster* Guen.) was probably the most common species in field and garden.

WHEAT STEM MAGGOT (*Meromyza americana* Fitch).—In some fields the infestation exceeded five per cent. of the straws which is greater than usual. Injury was rather widespread.

WHEAT STEM SAWFLY (*Cephus cinctus* Nort.)—Infestation was about the same as last year but damage was somewhat greater due to high winds breaking the straws.

GARDEN INSECTS

SIX-SPOTTED LEAFHOPPER (*Cicadula 6-notata* Fall).—This leafhopper was very abundant on a great variety of plants including turnips and garden flowers in the western part of the province.

WESTERN BLISTER BEETLE (*Lytta nuttalli* Say).—One of the principal features of the season was the appearance of enormous numbers of these beetles which attacked caragana hedges and broad beans over a wide territory. First specimens were received at M. A. C. on June 22 and adults continued to arrive until the end of July although they were received most abundantly during the first week of July.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata* Say).—This beetle was very abundant and widespread.

SPOTTED CUCUMBER BEETLE (*Diabrotica duodecimpunctata* Fab.).—Never previously has this beetle been so numerous at M. A. C.

STRIPED CUCUMBER BEETLE (*Diabrotica vittata* Fab.).—These were more common than usual.

BEAN LEAF BEETLE (*Cerotoma trifurcata* Forst).—A half dozen adults were found on beans at M. A. C. They have not been noted here previously.

STRAWBERRY ROOT WEEVIL (*Brachyrhinus ovatus* L.).—In one instance these beetles occurred on the kernels of green corn from Rossendale

IMPORTED CABBAGE WORM (*Pieris rapae* L.).—These were somewhat less numerous than usual.

CORN EAR WORM (*Heliothis obsoleta* Fab.).—These worms were more abundant than usual when table corn was ready for use.

BEET WEBWORM (*Loxostege sticticalis* L.).—During the last three weeks of August numerous localities in the south-western part of the province reported the presence of these insects on Russian thistle, Canadian thistle, pigweed, raspberry and vegetables.

WESTERN SOD WEBWORM (*Crambus dorsipunctellus* Kearn.).—This is a new pest found damaging lawns near Winnipeg.

RED SPIDER (*Tetranychus telarius* L.).—Roses, vegetables, sweet peas, dahlias, etc. were injured but damage was less general than in 1930.

FRUIT INSECTS

PLUM CURCULIO (*Conotrachelus nenuphar* (Hbst.)).—Adults were reared from Ojibwa plums which were badly infested in the Manitoba Agricultural College orchard where the insect occurred in injurious numbers for the first time.

CURRENT SPANWORM (*Itame ribearia* Fitch).—This insect damaged the foliage of black currants, red currants and flowering currants in the Winnipeg area.

CURRENT FRUIT FLY (*Epochra canadensis* Loew.).—Damage was about as usual.

FOREST AND SHADE TREE INSECTS

BOXELDER BUG (*Leptocoris trivittatus* Say).—From the middle of September until the first of November many boxelder bugs were received from widely

scattered areas. Many complained that they entered houses and were difficult to remove. They constituted an entomological feature of the season.

ASPEN POPLAR LEAF BEETLE (*Lina tremulae* Fab.)—There was a very marked increase in this pest and large areas of young poplars were badly skeletonized by the larvae.

WILLOW LEAF BEETLE (*Galerucella decora* Say.)—Severe local out-breaks of this insect took place during which willows and occasionally balsam poplars were badly defoliated.

FALL WEBWORM (*Hyphantria cunea* Drury)—There was a notable increase in the numbers of this insect.

FALL CANKER WORM (*Alsophila pometaria* Harr.)—During late May and the first part of June fall canker worms damaged innumerable trees and shrubs in the Winnipeg area. Reports of injury were received westward to Portage la Prairie. The ground beetles (*Calosoma frigidum* Kby.) and (*Calosoma calidum* Fab.) appeared in great numbers and destroyed many larvae and pupae.

LIME-TREE LOOPER (*Erannis tiliaria* Harr.)—This was very common at Manitoba Agricultural College associated with fall canker worm.

BROWN-HEADED SPRUCE SAWFLY (*Pachynematus ocreatus* Harr.)—This insect injured transplanted white spruce especially, near Winnipeg.

HOUSEHOLD AND LIVE STOCK INSECTS

BEDBUG (*Cimex lectularius* L.)—Bedbugs were plentiful and many inquiries concerning relief were received.

REAL STINK BEETLE (*Nomius pygmaeus* Dej.)—On July 7 specimens of this extremely malodorous beetle were received from Pine Falls where it occurred in a home much to the discomfort of the owners.

BLACK CARPET BEETLE (*Attagenus piceus* OI.)—At both Winnipeg and Portage la Prairie these beetles were reported plentiful.

WHITE-MARKED SPIDER BEETLE (*Ptinus fur* L.)—Damage was done in several warehouses in southern Manitoba.

INDIAN-MEAL MOTH (*Plodia interpunctella* Hb.)—Specimens of this moth were reared from dry stored combs of beeswax at Coulter.

MOSQUITOES.—Very little annoyance was occasioned by mosquitoes throughout the province. Many sloughs and ponds which formerly contained water were dry throughout the season.

BULL DOG FLIES (*Tabanidae*)—They were less plentiful than in normal years.

WARBLE FLIES.—These were very numerous in the backs of cattle over a wide area in the province.

ANTS.—These were troublesome in houses, on lawns and in flower gardens.

NORTHERN FOWL MITE (*Liponyssus sylviarum* C. & F.)—This occurred on fowl in at least two poultry buildings at Winnipeg. This is probably a record for Manitoba.

INSECTS OF THE SEASON 1931 IN SASKATCHEWAN

K. M. KING* AND A. P. ARNASON

Dominion Entomological Laboratory, Saskatoon, Sask.

Undoubtedly the worst general outbreak ever recorded for insect pests of Saskatchewan crops, occurred in 1931.

FIELD CROP PESTS

PALE WESTERN CUTWORM (*Agrotis orthogonia* Morr.)—The outbreak of this cutworm was the most generally extensive that has ever occurred in the history of the province. Although its range was not greatly extended beyond that of 1930, there were severe ravages in the margin of the park belt, where the pest had never previously been of economic standing. Particularly heavy losses occurred in the Aberdeen-Sutherland, Colonsay-Elstow, and Hughton-Eston areas, where there was considerable crop.

RED-BACKED CUTWORM and allies (*Euxoa ochrogaster* Gn., *E. tessellata* Harr., *E. flavidollis* Sm., *E. verticalis* Grt. and others).—In general, cutworms of this type were considerably less important than in 1930, although present in equal if not greater numbers along a broad area towards the margin of the park belt, in northwestern, central and southeastern Saskatchewan; infestations, especially in gardens, also extended for a considerable distance into the adjoining prairie country. As a result, an unusual feature of the year was the great admixture in many such localities of infestation involving both red-backed and pale western cutworms, in all proportions.

THE ARMY CUTWORM (*Chorizagrotis auxiliaris* Grt.) was destructive in a few places in extreme southern Saskatchewan. The **EARLY CUTWORM** (*Euxoa tristicula* Morr.) was numerous and widely distributed in the southwest "third" of the agricultural area, but caused very little injury to crops.

WIREWORMS.—The long period of low moisture was evidently conducive to a very high rate of damage by this pest. Seed injury was unusually great. There was exceptional delay in the production of secondary roots, and any stem injury prior to that was almost invariably fatal to the seedling. Replacement of injured crops by heavy weed growth was found in most of the open prairie country where wireworm infestations are most common and severe, and *Ludius tinctus* Lec. is the chief species. Scattered damage also occurred in northern and eastern districts, in the black soil or park country, where *Dolopius lateralis* Esch. and *Cryptophysus nocturnus* Esch. were of chief importance.

GRASSHOPPERS materially damaged crops in many localities in southern Saskatchewan, and constitute a very serious threat for the near future. The lesser migratory locust, *Melanoplus mexicanus* Saus., was the species of chief importance, although *M. packardi* Scud., was also generally abundant. In only a few localities was the roadside grasshopper, *Camnula pellucida* Scud., observed to be common.

FALSE WIREWORMS (*Blapstinus moestus?* Melsh) were very numerous in parts of southern and western Saskatchewan.

WHEAT-STEM SAWFLY (*Cephus cinctus* Nort.)—The percentage of crop loss attributable to this pest was apparently higher than in 1930, although in many localities the general infestation was probably somewhat reduced owing to the greatly delayed crop growth.

*Notes utilized in preparing this summary have been supplied by officers of the Saskatchewan Dept. of Agriculture; the University of Saskatchewan; and colleagues of the Entomological Branch.

SPINACH CARRION BEETLE (*Silpha bituberosa* Lac.)—An interesting observation was reported by G. F. Manson, of slight injury to wheat by adults of this species, in fields near Weyburn.

GARDEN AND FRUIT PESTS

CUTWORMS were again the chief pests in vegetable gardens, although perhaps not quite so generally troublesome as in the previous year.

WIREWORMS were very troublesome to potatoes and lettuce particularly.

BEET WEBWORM (*Loxostege sticticalis* L.) was very abundant on lamb's quarters and Russian thistle in nearly all parts of the province. Considerable injury was caused in gardens, and flax and sunflowers in a few fields were seriously attacked.

POTATO BEETLE (*Leptinotarsa decemlineata* Say).—Damage by this pest was nearly double that of 1930, and extended over a wider area.

CARAGANA BEETLE (*Lytta nuttalli* Say)—Caused severe losses of broad beans in several places, a five acre field being ruined at Saskatoon. Caraganas were also heavily attacked in most areas.

IMPORTED CABBAGE WORM (*Pieris rapae* L.)—Generally abundant and injurious.

CORN EARWORM (*Heliothis obsoleta* Fab.)—This species caused some injury to corn in rather widespread localities, and about $\frac{5}{8}\%$ loss of ears in a 5-acre field of corn at Indian Head. This is a rare occurrence for Saskatchewan.

WHITE GRUBS (*Phyllophaga* sp.)—One report was received and referred to 1930 when potatoes were damaged at Pike Lake; the first record of economic importance in central Saskatchewan.

Among other garden pests reported were: fleabeetles numerous in the spring; the imported currant worm (*Pteronidea ribesi* Scop.), the onion and the cabbage root maggots.

OTHER INSECTS

Stored grain products were seriously infested in several instances reported. The CONFUSED FLOUR BEETLE (*Tribolium confusum* Jacq. Duv.) was the chief of these and seems to be increasing in local importance. Other species were the Indian meal moth, the Mediterranean flour moth, the flat grain beetle (*Laemophloeus pusillus* Schon.) and the cadelle (*Tenebriodes mauritanicus* L.).

BEDBUGS (*Cimex lectularius* L.) were the subject of more complaints even than in 1930. In one instance, specimens were received with a report of heavy infestation in a hen house, at Kinley.

THISTLE BUTTERFLY (*Vanessa cardui* L.)—Larvae of this species were so numerous in many localities that thistles of various kinds were severely checked or even destroyed.

Houseflies seemed to be more than usually troublesome in the fall.

MOSQUITOS were generally very scarce, except in northern Saskatchewan, although, interestingly, adults of *Anopheles maculipennis* were more common than usual.

Moths of the army cutworm were so abundant as to be an annoying pest in the early summer, from their habit of entering houses. Almost the entire province was affected in some degree, indicating the powers of flight of this moth.

INSECTS OF SHADE AND ORNAMENTAL PLANTS OF THE SEASON
1931 IN THE PRAIRIE PROVINCES

K. E. STEWART

Entomological Laboratory, Indian Head, Saskatchewan

SPRUCE MITE (*Tetranychus ununguis* Jac.)—This pest again caused widespread damage to spruce trees and other conifers. During the last three years this mite has increased to such numbers that it is now the most serious pest to spruce trees over the Prairie Provinces. Their feeding activities coupled with the exceptionally unfavorable weather conditions for tree growth, has played havoc with a large percentage of planted spruce. Native white spruce growing in the wooded sections of Saskatchewan and Manitoba were also found to be heavily infested this year.

COMMON RED SPIDER MITE (*Tetranychus telarius* Linn.)—This was a widely distributed and destructive pest on Russian poplar, native cottonwood, balsam poplar, aspen poplar, willow, elm, currants, roses, raspberries, a partial list of the plants seriously infested. The heaviest infestations occurred in southern Manitoba, southern Saskatchewan and southern Alberta.

WILLOW LEAF BEETLE (*Galerucella decora* Say)—The larvae of this beetle caused total defoliation of willow over a large area in Manitoba, Saskatchewan and Alberta. The largest and most heavily infested areas included the following centres:—Rosetown, Sovereign, Wainwright, Vermilion, Lloydminster, Battleford and Borden.

ASPEN POPLAR LEAF BEETLE (*Lina tremulae* Fab.)—This beetle occurred in enormous numbers and was very destructive to aspen poplar in south central Manitoba.

COTTONWOOD BLOTH-MINER (*Zeugophora* sp.)—A very large increase of damage by this beetle was noted this year, generally distributed throughout the Prairie Provinces; the greatest injury occurred in south central Saskatchewan and Alberta. In southern Saskatchewan cottonwood and northwest poplar were 50 to 100% infested.

FALL CANKERWORM (*Alsophila pometaria* Harr.)—Manitoba maple, white elm and a variety of ornamentals were seriously defoliated in Manitoba. Areas of heaviest infestation centred around Morden, Winnipeg, Portage la Prairie and Dauphin.

WESTERN BLISTER BEETLE (*Lytta nuttalli* Say)—There was an increase of injury by this beetle this year. *Caragana*, peas and beans were attacked. In Manitoba they were serious in the Morden area. A large area in Saskatchewan was infested, extending from southeast of Saskatoon to Imperial and east to Big Quill Lake. Reports were received from Edmonton and Medicine Hat, Alberta, indicating damage.

SAMIA CECROPIA L. OR S. GLOVERI STKR.—In portions of south central Saskatchewan centring around Mossbank, Assiniboia and east to Ogema, defoliation of young Manitoba maples ranged from 75 to 100%. Older maples were not so seriously injured.

BLACK WILLOW APHID (*Melanoxantherium smithiae* Monell)—The black willow aphid was very prevalent in south central Saskatchewan and Alberta.

POPLAR LEAF-FOLDING SAWFLY (*Pontania bozemani* Cooley)—This pest caused 5 to 10% injury to foliage of cottonwood and Russian poplar throughout the Prairies.

OAK LACE-WINGED BUG (*Corythucha arcuata* Say)—Severe foliage injury was caused by this bug on native bur oak throughout most of Manitoba.

PINE NEEDLE SCALE (*Chionaspis pinifoliae* Fitch)—This scale has become more widespread and more plentiful on spruce during the last two or three years. There is hardly a plantation where this insect has not become established.

SPRUCE PINEAPPLE GALL APHID (*Adelges abietis* Kalt.) and SPRUCE GALL APHID (*Adelges similis* Gill) were again in evidence this year throughout Manitoba, Saskatchewan and Alberta. In portions of Alberta, spruce trees have been seriously injured.

YELLOW-HEADED SPRUCE SAWFLY (*Pachynematus ochreatus* Harr.) partially defoliated a large number of spruce trees at Dauphin, Manitoba.

SPOTTED TUSSOCK MOTH (*Halisidota maculata* Har.) and the RUSTY TUSSOCK MOTH (*Notolophus antiqua* Linn.) were noted throughout the three Prairie Provinces. However, very little actual injury was noticed as a result of their presence.

A number of apple trees and caragana were severely infested with SCURFY SCALE (*Chionaspis furfura* Fitch) at the Dominion Experimental Farm, Morden, Manitoba.

ROSE CURCULIO (*Rhynchites bicolor* Fab.)—The activities of this beetle causes great annoyance to rose growers in Manitoba, Saskatchewan and Alberta. In a great many cases every bud on a rose bush will be punctured. This year the injury appeared to be more severe than usual.

INSECTS OF THE SEASON 1931 IN SOUTHERN ALBERTA

By H. L. SEAMANS

Dominion Entomological Laboratory, Lethbridge, Alberta

Cutworms were undoubtedly the most abundant and wide-spread of the insect pests of 1931.

The EARLY CUTWORM (*Euxoa tristicula* Morr.) over much of southern Alberta was present in almost every field and garden.

The PALE WESTERN CUTWORM (*Agrotis orthogonia* Morr.) was the most widespread of the pests of the year. It was present over an area extending from Lethbridge, Alberta, to Woolseley, Saskatchewan, east and west from the International Boundary to north of Saskatoon in Saskatchewan and to Stettler in Alberta. This comprises an area of about 150,000 square miles of which all but about 20,000 square miles were infested with numbers to cause severe economic damage.

The RED-BACKED CUTWORM (*Euxoa ochrogaster* Gn.) was present in less numbers in the irrigated areas and in central Alberta than in 1930. There were some severe infestations of this species mixed with the pale western cutworm in the areas bordering on the open prairie country and extending into the park land areas.

GRASSHOPPERS—Several localities began reporting serious grasshopper infestations in June. By August 5 it appeared as though the greater portion of Alberta south of Calgary would have some trouble. (*Melanoplus bivittatus*) and (*M. mexicanus*) were the most abundant species. The first named was more plentiful than ever reported in Alberta. Considerable damage was done to

winter rye after it was cut and late crops of oats and wheat suffered severely. Very few (*Camnula pellucida*) have been seen.

BLISTER BEETLES—Nuttall's blister beetle, (*Lytta nuttalli*) was unusually abundant over most of southern Alberta. It was reported seriously injuring caragana hedges, broad beans, peas and alfalfa. In the latter case it fed almost exclusively on the blossoms causing serious losses in seed production.

THISTLE CATERPILLAR. (*Vanessa cardui*)—For the first time since 1925 reports were received of large areas of Canada thistle heavily infested with this caterpillar. It was apparently scattered over all of Alberta south of Red Deer. Many large and vigorous patches of Canada thistle were wiped out.

WHEAT STEM SAWFLY (*Cephus cinctus* Nort.)—While this insect has been present in south central Alberta for many years it attracted more attention this year because of the peculiar growing conditions. Early crops were almost wiped out by this insect and losses vary from 25 to 100 per cent. in such fields.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata* Say)—This species was abundant before potatoes had even been seeded and by the time the plants were four inches high, spraying was necessary. Some of the growers sprayed or dusted once a week in order to keep the plants from being stripped. For the first time on record this insect was a serious pest as far north as Stettler, Alberta; although it has been found present much farther north.

RED SPIDER (sp.)—This mite is usually of some importance only in small fruit gardens of southern Alberta where it attacks raspberries. This season it has been reported as injuring all small fruits as well as shelter belts. Russian poplar seems to be seriously attacked and the web was so abundant that the lower trunks and branches were coated to a depth of three and four inches.

APHIDS—Aphids of all species were very abundant this season. Cabbage aphid—(*A. brassicae* B.) completely defoliated some fields of turnips in the Lethbridge district. Cabbages suffered to some extent but were not so severely damaged. Shade trees of all kinds were severely infested with aphids which caused the leaves to turn yellow and drop prematurely. Practically all garden flowers were attacked by aphids and sweet peas suffered severe damage.

Coccus confusus Cockerell—This mealy bug was found to be abundant on several clumps of prickly pear cactus (*Opuntia* sp.) The infested clumps were sickly and many of the fleshy stems were shrivelled. This is the first time this insect has been noticed in the Lethbridge district.

INSECTS OF THE SEASON 1931 IN NORTHERN ALBERTA

E. H. STRICKLAND

University of Alberta, Edmonton, Alberta

This report deals mainly with insect conditions in the Peace River District. Information from elsewhere has been gained only through correspondence.

Both in the Peace River District, and throughout the greater part of Northern Alberta, rainfall, though it came a little late in the season, has been somewhat in excess of normal. Crop conditions have been excellent though growth was seriously retarded by cool windy weather early in the spring.

WIREWORM (*Ludius aeripennis*) damage was severe in the Peace River District during May, although the wireworm population was not very high in the majority of fields. With increased temperatures in June, associated with frequent showers, many of the damaged plants recovered.

THE RED-BACKED CUTWORM (*Euxoa ochrogaster*) destroyed a large number of gardens in the Peace River District. It was, however, less abundant than in 1930. Associated with it were large numbers of *Agrotis fennica*. Elsewhere in Northern Alberta there was very little damage from this insect.

THE FALL ARMY CUTWORM (*Chorizagrotis auxiliaris*) in the adult stage, was unprecedently abundant throughout Northern Alberta. This is usually a somewhat rare insect north of Red Deer. Specimens of the moths, which swarmed in houses, were sent in for identification from widely scattered places. Larvae were taken in moderate numbers in alfalfa in the Peace River District during May. No complaints of actual damage were received but it is possible that some of the generalized "cutworm" complaints had reference to this insect.

THE PALE-WESTERN CUTWORM (*Agrotis orthogonia*) spread during the year into the southern portion of our territory. At Consort there was some damage, and the moths are reported to be quite prevalent this fall throughout this area.

THE BERTHA ARMY-WORM (*Barathra* Spp.) appears to have declined in numbers over our entire territory. Specimens of the larvae were sent in to the laboratory once, only, for identification.

FLEA-BEETLES (*Phyllotreta* Spp.) are becoming increasingly injurious in gardens in the Peace River District. Beets and various Cruciferous crops were in many instances completely ruined in 1931.

GRASSHOPPERS were nowhere present in sufficient numbers to cause appreciable damage in the northern part of the province. They are, however, increasing in abundance in many districts. *Melanoplus mexicanus*, and *bivittatus* are the species that are attracting the greatest attention in cultivated land. It is reported, also, that *Cannula pellucida* adults are unusually abundant in the Coronation area.

THE WHEAT-STEM SAWFLY (*Cephus cinctus*) was more abundant in the southern part of our territory than it was in 1930. A comparatively dry season in 1931 will result, in all probability, in increased damage in 1932.

THE BLACK WILLOW APHIS (*Melanoxantherium smithiae*) continues to be a serious pest of poplars on the open prairies.

THE CLOVER MITE (*Bryobia pratensis*) has invaded a number of houses in Edmonton and Calgary..

THE THISTLE BUTTERFLY (*Vanessa cardui*) has been unusually abundant in the Southern part of this territory. It has undoubtedly weakened many patches of its favoured food plant, the perennial Canada thistle. It is doubtful whether it has eradicated many of these, as is frequently claimed.

Generally speaking, insects were not very abundant during the season though a number of species that are not often seen in this part of the country were more numerous than is usual.

INSECTS OF THE SEASON 1931 IN BRITISH COLUMBIA

E. R. BUCKELL

Dominion Entomological Laboratory, Vernon, B.C.

The season in British Columbia was, in many ways, very similar to that in 1930. Insects as a whole were extremely scarce, particularly so in respect to the Lepidoptera and general collecting was very poor indeed.

FOREST INSECTS

Forest Insects seem to have found this season favourable for their development and the situation in British Columbia and in the northwestern United States remains serious.

DOUGLAS FIR TUSSOCK MOTH (*Hemerocampa pseudotsugae* McD.)—Although very numerous and destructive in 1930 this species has almost disappeared this summer and only a few small scattered outbreaks were recorded.

HEMLOCK LOOPER—This insect was not so numerous as in 1930, although present in injurious numbers in coastal sections. No aeroplane dusting was undertaken for its control as in 1930.

TIP MOTH (*Peronea variana* Fern.)—The tip moth continues to be numerous on hemlock and Douglas fir on the coast and has been reported in outbreak form this summer on Queen Charlotte Islands.

BARK BEETLES—The very severe outbreak of bark beetles which has been in evidence during the past few years still continues but the peak appears to be past and the numbers of the beetles on the decline.

TENT CATERPILLARS—Both the forest and the orchard tent caterpillars are extremely scarce this season.

SATIN MOTH (*Stilpnobia salicis* Linn.)—The satin moth continues to spread on Vancouver Island and on the mainland in the Lower Fraser Valley.

TREE-FRUIT INSECTS

The general situation in the orchards during 1931 was good and no severe insect outbreaks occurred.

The outlook for 1932 is not quite so favourable, as several species show undoubted signs of increase.

CODLING MOTH (*Carpocapsa pomonella* Linn.)—This pest showed a considerable increase this season over 1930 and in some sections the situation is worse than has been experienced before.

OYSTER-SHELL SCALE (*Lepidosaphes ulmi* Linn.)—This scale, which is one of our major pests of the orchard, and whose control is at present far from satisfactory, increased enormously this season.

BLISTER MITE (*Eriophyes pyri* Pagen)—A general alarming increase of this mite occurred this season.

RED MITES—A very noticeable increase of red mites occurred this season in the Okanagan Valley and control measures will be necessary next season or severe damage may result.

WOOLY APHIS (*Eriosoma lanigera* Hausm.)—This aphid was more prevalent in the Okanagan Valley than for many years, owing probably to the extremely moderate winter of 1930-1931.

TARNISHED PLANT BUG (*Lygus pratensis* Linn.)—This bug showed a decrease over last season and very little damage from it was reported.

LESSER APPLE WORM (*Laspeyresia prunivora* Walsh.)—This apple pest was very scarce this season.

PEACH TWIG BORER (*Anarsia lineatella* Zell.)—Fairly numerous in some orchards but nowhere in outbreak numbers.

MEALY BUG.—This insect is increasing slowly in several parts of the province but, as yet, has not caused any damage.

FIELD CROP INSECTS

GRASSHOPPERS—After several years of comparatively scarcity the various species of grasshoppers are again becoming numerous and there is every indication that another outbreak may be expected during the next few years.

WIREWORMS—Wireworms appear to vary very little in severity from year to year but continue yearly to take an enormous toll of field crops throughout every section of the province.

CUTWORMS.—Cutworms were unusually severe this season during the early months and a great deal of damage was done by them to early plantings of tomatoes.

ROOT MAGGOTS.—These were not in any great numbers but some onion and cabbage patches suffered severely.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata* Say)—This beetle remains confined to the eastern corner of the province. This season report indicates that the pest is well under control and in less numbers than in former years.

SOME NOTES ON THE CYCLAMEN MITE (*Tarsonemus pallidus* BANKS)

A PEST OF STRAWBERRY PLANTS

By ALAN G. DUSTAN and W. G. MATTHEWMAN

Entomological Branch, Ottawa.

Although long known as a serious pest of cyclamen and other greenhouse plants, it is only within the past three years that the cyclamen mite has attracted attention as a field pest of strawberries. This article has been written with the purpose of calling attention to the pest and to give a brief outline of the work that has been done at Ottawa.

The study of the mite was commenced (at Ottawa) late in the fall of 1928. For a few years previous to this time it had been noticed that a great percentage of the plants in the strawberry beds at the Central Experimental Farm had failed to develop in the normal manner; there was a distinct repression of growth, the leaves became dwarfed and curled and practically no fruit was produced. A preliminary study made at the request of the Division of Horticulture showed the injury to be the result of the attack of the cyclamen mite (*Tarsonemus pallidus* Banks). The present investigation was started with a view to studying the biology of the mite and to devising some method for its control.

The cyclamen mite, although not yet generally distributed throughout Canada, is nevertheless established in plantations in widely separated districts. Field infestations have been reported from Massachusetts, New York, Manitoba, New Brunswick and many points in Ontario and Quebec. In the vicinity of Ottawa very few commercial plantations may be found which are entirely free from the attacks of the mite and it is altogether likely that a check-up would show a much greater distribution.

The injury to the plants when at all serious is highly characteristic. The mites probe the tissues with their styliform mandibles, and in sucking up the juices of the cells, leave the injured parts shrivelled. The continued growth o

the surrounding tissue causes severe distortion and dwarfing of the leaves, and even when the infestation is only slight, the injured portions of the leaf will take on a peculiar coppery-bronze appearance. The shortening of the petioles, the underrolling of the margins at the bases of the leaflets and the stunting of the plant as a whole, are typical of severe mite injury.

Usually the injury to a plantation the first year is not severe. The second year, however, where the mite has become well established, serious injury practically to the whole plantation may result. Badly infested plants put forth few or no runners, the yield of fruit is decidedly curtailed and that fruit which is produced is distorted and dwarfed. If the plantation is carried over to the third year, which is the practice with some growers, the infestation may have reached such proportions that entire rows will produce no fruit and completely blank spaces will be left in the plots.

With a little practice the mites may be discovered with the naked eye. Careful search in the crowns of the plants will disclose the presence of the adults which appear as minute, amber-coloured specks. Upon closer inspection, by carefully opening the unfolded leaflets, the whitish eggs and immature forms may be distinguished. A hand lens, however, greatly simplifies the finding of the mites and a binocular is necessary for the proper rendering of any detail.

The mites over-winter in the field on the plants themselves. Hibernation takes place in the crowns, where the long hairs beneath the leaf sheaths at the bases of the petioles furnish them with ample protection. As far as it is known, only the adult females winter over. Males have been found present on plants before the first of May but it is probably that these are the product of the first generation.

Toward the middle of April, depending of course upon favourable weather conditions, the hibernating females commence egg-laying. The relatively large, pearly-white eggs upon hatching give rise to an immature or larval stage. The larvae, which are pure white in colour and have only three pairs of legs, feed actively and as they feed their elastic or wrinkled skin is slowly stretched out; moulting occurs only during transformation to the adult.

At the close of the larval period the mite enters a short resting or quiescent stage. The quiescent form consists of the engorged larva which in this stage is motionless and clumsy looking; it is white in colour and slightly hyaline. Upon completion of various physiological changes the quiescent form moults and transforms to the eight-legged adult.

With the coming of warm weather the mites increase in number rapidly. From the middle of June to the end of July the infestation is at its peak and during this period as many as three hundred adults may be found upon a single plant. Egg-laying commences to slowly decrease early in August but ends finally only in October.

Throughout their entire life-history the mites are rarely found on the older leaves or more exposed parts of the plant. As with all Tarsonemid mites they are strongly sensitive to light and are always found concentrated in the crowns where they seek the sheltered and more succulent unfolded leaflets. The basis of the petioles by the stipules are favorite positions in the spring and fall, but in midsummer by far the largest numbers are found in the folds along the midribs of the unfolded leaflets, and between the three leaflets themselves. The densely matted hairs of these parts furnish shelter and support for the numerous egg, larval and quiescent forms.

Undoubtedly the propagation of runner plants from infested parents is responsible for at least the greater part of the distribution of the mite. In almost

all cases where the parent plant is found to be infested, the daughter plants will likewise be infested even before they have become rooted in the soil; in fact it has been proven that the mites actually grow out with the runners; once the young plants have become established there is little or no migration back and forth between the old and new plants.

But while the spread of the infestation from row to row, and even from plant to plant, takes place comparatively slowly, the discovery of mites on wild plants some distance from cultivated ones, and the occurrence of infested plants amongst stock grown from seed, indicate strongly that there must be some method of dissemination other than the sample propagation of infested plants.

That the mites are wind-borne has been definitely proven by means of traps consisting of sheets of bristol broad which were smeared with "tanglefoot" and set out in infested plantations. Considerable time has been spent in attempts to discover other probable ways of migration but all efforts have been unsuccessful. All observations rather than direct experimental evidence tend to show that migration does not take place by way of the soil. Examination of soils surrounding infested plants have not disclosed the presence of any mites. Moreover, it is doubtful if the soil could be a principal means of dissemination. The cyclamen mite is characterized by a moist, sticky coating to which particles of soil adhere and greatly impede the movements of the mites; experiments show that when mites are placed in soil, under the most favourable conditions they succumb in seven or eight days, and when exposed to the sun they perish within an hour.

Likewise attempts to discover other possible ways of distribution, such as the conveyance of the mites on tools and clothing, or by other insects, have met with no success. It is felt that if such means of migration do exist, they must be negligible as compared with the dissemination of the mites by the wind and by the propagation of infested runner plants.

The comparatively slow spread of the mite somewhat simplifies its control. Since it is doubtful if any satisfactory field control could be evolved, the finding of a treatment which would free the young plants of mites prior to their being set out has been concentrated upon. It was felt that if all the plants in a new plantation were freed of mites, the spread of the disease by wind and other unknown factors would be so slow that little damage would be done by the mite in the two years' practice of the commercial grower.

The use of fumigants was thoroughly tested during the summer of 1929. In all cases it was found that, owing to the sheltered positions of the mites in the crowns, the various fumigants tested fatally injured the plants long before they were able to penetrate sufficiently to kill the mites. Nicotine sulphate when used as a dip gave no more success, while such substances as powdered sulphur and tobacco dust were clearly valueless. The effect of both moist and dry heat, tested by means of an electric oven, also caused fatal injury to the plants.

However, the testing of hot water dips as a means of freeing the transplants of mites has met with more favourable results. During the summer of 1929 it was found that the subjection of the young plants to hot water at a temperature of 105° F. for three-quarters of an hour would kill the mites without appreciably injuring the plants. This control was simplified greatly in 1930 when it was found that by raising the temperature of the water to 115° F. the time of exposure could be cut down to five minutes. While this treatment cannot be said to yield one hundred per cent. control, it apparently kills fully 98% of the mites.

Unfortunately, little opportunity has presented itself to thoroughly test the control under field conditions. At the laboratory, however, in all cases where healthy plants were dug, treated and set out in the insectary garden without

storing before or after treatment, they quickly recovered from the effect of the hot water; in fact it could not be noticed that this bath had any appreciable ill effect upon the young transplants. Since the comparative ease with which the plants can be treated makes such a treatment particularly valuable to commercial growers and breeders alike, control of the cyclamen mite seems hopeful.

The absence of a thorough testing of the hot water bath under field conditions does not warrant its recommendation as a control as yet, but certain cultural practices and precautions should be of value in preventing the distribution of the mite or in lessening the damage resulting to a plantation once the pest has become established.

It is of the utmost importance in setting out a new plantation, or in obtaining plants from another grower, that only stock which is known to be mite-free should be used. The shipment of plants from an infested plantation is undoubtedly the biggest factor in the distribution of the mite. With plantations which already are infested, the cropping of the beds for one or, at the most, two years is recommended, and where severe injury to the plants the first year seems general it would probably be wiser to plough under the entire plantation once it has been cropped.

In plantations where only a few infested plants are noticed, immediate roguing might prevent the spread of the pest throughout the plots. In any case, the bed should be reset with entirely new, mite-free stock rather than with young runner plants from the infested parents; propagating from infested parent stock from year to year will certainly cause the spread of the mite over the whole plantation.

Where it is not practicable to set out the new plots in a different situation, the new plantation should not be planted out over the old one for at least six weeks. Experiments have shown that mites can exist on buried plants for as long as four weeks, and there is some danger that mites from the old ploughed-under plants might work their way up through the soil and cause an infestation of the new beds.

THE BLACK VINE WEEVIL (*Brachyrhinus sulcatus* Fab.) ATTACKING JAPANESE YEW

By R. W. THOMPSON

Ontario Agricultural College, Guelph

In Juhe, the manager of one of the larger Ontario nurseries reported considerable damage to *Taxus cuspidata* L. by the black vine weevil. Propagation bed material as well as trees in the nursery row were injured at the time I visited the nursery. The trees were about two feet high and worth in the neighbourhood of three dollars apiece. Over a hundred of these trees had been totally destroyed.

It is possible that this insect had been present in the nursery for a number of years without doing sufficient injury to attract attention. The dry summer of 1930, followed by a mild winter, may have been responsible for a large increase in population and a consequent increase in injury.

INJURY

Taxus was the only evergreen attacked. Others such as balsams, pines, cedars and spruces which were immediately adjoining both the propagation beds and the nursery rows, were untouched. Screens placed over the propagation

beds did not save the *Taxus* from injury. The adults probably gained entrance through badly fitting joints in the frames or through the soil under the frames.

Seedling material was injured by the larvae chewing off the primary or tap roots. This condition was present in every dead seedling examined. Secondary root systems which were present were not sufficient to keep the seedlings alive. The root systems of the trees in the nursery row were reduced to mere skeletons by the destruction of the small roots. Even the larger roots, as thick as a lead pencil were stripped bare of bark.

Stage of Development, June 25th.—Material collected on June 25 showed development at that date to be approximately 15 per cent. larvae, 50 per cent. pupae and 35 per cent. adults. Larvae and pupae around trees were found from $1\frac{1}{2}$ inches below the surface to 7 inches. The position of some of the larvae, close to the roots, and the fact that these were not in pupae cells, indicated that feeding was still in progress at this date.

In the nursery row, where the trees were about two feet apart, the adult population per tree averaged six. These were nearly always in a group on the south side of the tree, although solitary individuals could be found in some other situations around the crown of the tree. Some adults were above ground, others hidden beneath small lumps of soil.

CONTROL EXPERIMENTS

A large number of these adults were put into a Riley cage with freshly transplanted strawberry plants. These were used to check controls which had already been tried in the field and also to try out other control substances which might give better results.

Baits.—Downes, of Victoria, B.C., had good success against a closely related species *Brachyrhinus ovatus*, with a poisoned raisin bait. Boston, Mass., nursery men, substituted arsenate of lead for the sodium fluosilicate used by Downes in this bait and had similar good results against this vine weevil. The Ontario nursery man in question therefore tried this poison bait on his seedling beds and young trees. The results obtained were unsatisfactory.

Observations indicated that his method of application was very faulty and I therefore decided to try out this bait, with others, in cages. The bait was made up from the Downes formula thus:—

50 pounds raisins (Sultana variety)
5 quarts water
5 pounds sodium fluosilicate
50 pounds "shorts"

The raisins are soaked in water six to twelve hours, then the surplus water is drained off and the raisins mixed with the combined poison and "shorts". The whole mixture is then ground slowly through a meat chopper fitted with the coarsest knife. Slowness is essential, otherwise the bait becomes heated and clogs the machine.

This bait killed all the adults both with the sodium fluosilicate and with the arsenate of lead. The lead was the slower of the two. Naturally the weevils came in contact with the bait much quicker than they would under field conditions. The explanation of the unsatisfactory results in the nursery is that the bait was deposited in heaps instead of being scattered lightly over the surface of the seedling beds and beneath the nursery trees. As the bait dried out quickly it was necessary to repeat it at least at intervals of not more than three days until all the adults had emerged.

Chopped apple was tried as a substitute for the raisins in cages but did not prove so satisfactory. The apple juice made the bait too sloppy, and when this condition was remedied it was found that it mildewed. In addition the chopped apple gave a lower percentage kill.

A piece of apple very lightly dusted with sodium fluosilicate failed to attract the weevils. Paris Green, sodium arsenate, sodium fluoride and mercuric chloride 1-1000, in very small doses over the surfaces of small pieces of apple, failed to show any results. Paris Green in a very thin film over stewed prunes also gave negative results, as they did not feed upon it.

Liquids.—The following is a list of the substances used either by myself or the nurseryman as contact or stomach poisons against the adults of *B. sulcatus*:

1. Carbon bisulphide (in propagation beds).
2. Red Arrow, 1-300, 1-350, 1-400.
3. Pysect, 1-400, 1-500, 1-600, 1-700, 1-800.
4. Lead arsenate 1-200 (2 pounds to 40 gallons of H_2O).
5. Bichloride of Mercury, 1-1000.
6. Derrisol, 1-400; Penetrol, 1-200.
7. Yokum Faust, Micable Oil, 1-20

The nurseryman applied carbon bisulphide to the propagation beds to control the larvae. At the first application insufficient material was applied to penetrate throughout the whole bed and as a result the larvae merely moved away to the gasless parts. At the second application this condition was remedied but no data was available as to how much material had been used, so these tests are inconclusive.

Red Arrow used in cages at the greatest strength gave complete mortality at the end of four days. It is possible that in the field a number of specimens died, but were not found.

Pysect.—This material was not so satisfactory in cages as Red Arrow. Incomplete mortality resulted from an application of a 1-400 dilution to adults hidden in the soil in cages.

Lead Arsenate.—This was applied as a mist spray to a strawberry plant in a Riley cage. Feeding occurred only on the night following the application. Complete mortality occurred at the end of five days. This experiment was repeated and results were identical. Adults in the check cages remained healthy. Unsatisfactory results had been obtained by the nurseryman from an application of arsenate of lime dust, but the job had been carelessly done and many of the seedlings had very little if any dust on them. The result was that no appreciable kill resulted from the application.

Mercuric Chloride, Derrisol plus Penetrol and Yokum Faust miscible oil did not kill when applied as sprays to adults in soil.

The conclusion I arrived at as a result of both cage and field experiments is that a combination of the poisoned raisin bait and an arsenate of lead spray (2 lbs. to 40 gals. of water) will give the best results against the adults. With this combination it is essential that the arsenical be applied very thoroughly and the bait be well spread around and repeated as soon as it dries and loses its attractiveness. The arsenical was suggested as a control because the foliage of *Taxus* both in the propagation bed and the nursery row showed clear evidence of adult feeding.

HISTORY OF THE ORIENTAL FRUIT MOTH INFESTATION IN THE
NIAGARA PENINSULA

WILLIAM A. ROSS,

Dominion Entomological Laboratory, Vineland Station, Ontario

The Oriental fruit moth, *Grapholitha molesta* Busck, was first discovered in the Niagara fruit belt in the fall of 1925, at which time extremely local and very light infestations were found at four points, viz. St. Davids, Peachland, Vineland, Station and Bartonville. The following year the insect occurred in outbreak form in a large orchard at St. Davids belonging to J. A. Calvert. This orchard was the centre of an infestation which had spread to Stamford on the south, the Niagara river on the east and to the lake shore on the north; west of St. Davids there had been little spread. What appeared to be isolated infestations occurred at the following points: in the vicinity of St. Catharines where the moth was confined apparently to the territory within a triangle formed by St. Catharines, Port Dalhousie and Port Weller, at Peachland, Vineland, Station, Grimsby Bartonville and Fonthill. During the next two seasons there was further spread of the insect and by 1929 it was present in all or practically all orchards in the fruit belt.

Six years ago many fruit growers and others, who saw something of the ravages of the insect in the Calvert orchard at St. Davids, felt very apprehensive about the outlook for the peach industry. Those who were most pessimistic looked ahead a few years and foresaw the time when practically all the peach orchards in the Niagara peninsula would be ruined by the insect, unless effective and economical control measures were discovered and adopted. However, realization has not quite come up to the pessimists' anticipations. It is true that the moth has caused serious losses to some individuals; that it has affected the demand for and consequently the price of peaches, *e.g.* in 1927 and 1929; and that it has cut down to some extent the planting of peach trees; but the fact remains that seven years after the Oriental fruit moth was first found, Niagara orchardists are still growing peaches which to a large extent are free of worms, and the peach industry is still flourishing.

Our infestation records*, and particularly those made in fourteen orchards, which have been under observation since 1926 and which are situated in various parts of the peninsula from the Niagara river to Bartonville, present four interesting features, viz.:

- (1) That the infestation along the lake shore at Vineland Station has been quite negligible and practically stationary for at least six years;
- (2) That the moth in most parts of the peninsula has made comparatively little headway, *e.g.* fruit injury has not exceeded 6.6. per cent. at Peachland, 1.6 per cent. at Jordan, 3.5 per cent. at Vineland Station, 5.6 per cent. at Beamsville, 6 per cent. at Grimsby Beach and 10.4 per cent. at Grimsby.
- (3) That severe injury has been almost wholly confined to the eastern end of the peninsula.
- (4) That in 1928, 1930 and again in 1931, there was a marked reduction in fruit injury.

The outstanding feature to my mind is the failure of the moth to make, in most parts of the fruit belt, anything like the headway we anticipated.

* All infestation or fruit injury records referred to in this paper pertain to our most important variety, the Elberta, a peach which matures about mid-September.

SUMMARY OF ORIENTAL FRUIT MOTH INFESTATION RECORDS—1926-1931.

PERCENTAGE FRUIT INJURY ON ELBERTAS

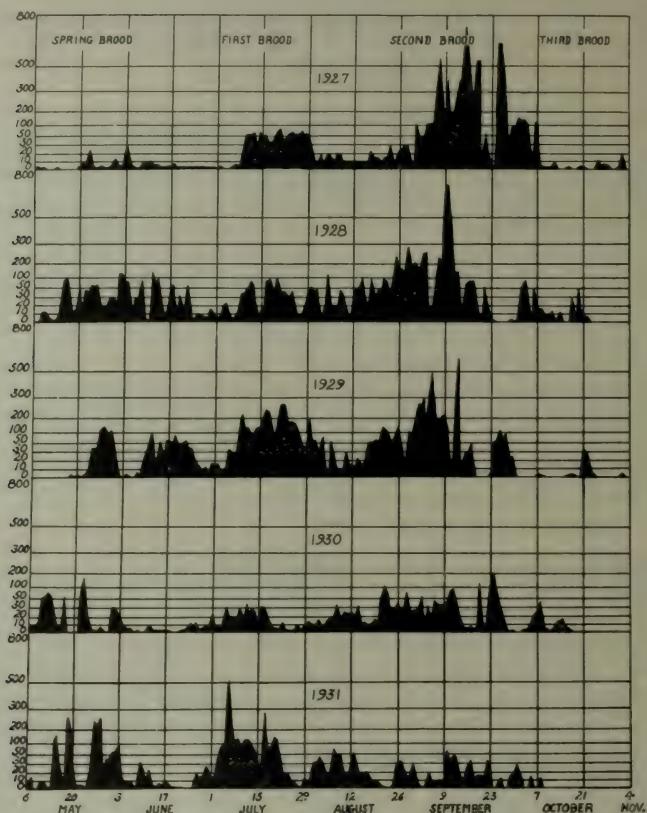
Grower's Name	Locality	1926	1927	1928	1929	1930	1931
<i>Fisher, C. H.</i>	Queenston		3.6*	10.8	47.2	6.3	7.0*
<i>Ramsay, A.</i>	Larkin Farm, Queenston	.....	.....	.....	.....	.....	4.4*
<i>Erwin, E. W.</i>	Queenston	.....	.....	.....	.....	11.6	7.3*
<i>Usher, J. D.</i>	Niagara-on-the-Lake	0.0	Trace	5.1*	73.7*	26.8	7.8*
<i>Rivett, T. B.</i>	Niagara-on-the-Lake	.....	.....	6.9*	.....	.....	.....
<i>Onslow, A.</i>	Niagara-on-the-Lake	.....	.....	.....	6.7	2.4*	.....
<i>Canadian Canners.</i>	St. Davids (in village)	.....	.....	25.4	.....	.....	.....
<i>Canadian Canners.</i>	St. Davids (½-mile west)	.....	.....	38.0	.....	.....	.....
<i>Cropp, D'Arcy</i>	St. Davids	.....	.....	66.0	31.4	13.8	6.1*
<i>Pendergast, R.</i>	St. Davids	.....	.....	.....	.....	.....	.....
<i>Smith, H. S.</i>	St. Davids	.....	37.8*	31.4*	.....	.....	.....
<i>Hannowell, J.</i>	St. Davids	.....	.....	12.2	.....	.....	.....
<i>Stephenson, C.</i>	St. Davids	.....	.....	.....	60.6	.....	.....
<i>Calvert, J. A.</i>	St. Davids	.....	.....	15.5	.....	.....	.....
<i>Warner, C.</i>	St. Davids	.....	58.6	64.0	30.3	46.3	10.4
<i>Armstrong, W. W.</i>	St. Davids	.....	.....	41.2*	18.2	.....	.....
<i>Collard, E.</i>	St. Davids	.....	26.6*	15.9	.....	20.0	30.5
<i>Robertson, G.</i>	St. Catharines	.....	52.1*	.....	.....	.....	.....
<i>Craise, H. (†)</i>	Peachland	?	6.3*	4.4*	33.3*	14.9*	4.3*
<i>Honsberger, M.</i>	Jordan Station	0	?	0.3*	5.2*	3.3*	6.6*
<i>Culp, A.</i>	Vineland Station	Present	0	0	1.5*	1.1*	1.6*
<i>Smith, A.</i>	Vineland Station	.....	2.8*	3.4*	3.5*	2.4*	1.9*
<i>Brown, G.</i>	Fonthill	0	Present	3.4*	.....	3.0	0.9*
<i>Taylor, J.</i>	Beamsville	0	0	0.3*	5.6*	0.4*	0.6*
<i>Woolverton, N. & H.</i>	Grimshy	0	0	0.5*	10.4*	3.9*	3.6*
<i>Fleming, H.</i>	Grimshy	0	0.7*	0.1*	5.9*	3.1*	6.1*
<i>Henry, E.</i>	Winona	0	0	0.5*	16.3*	3.4*	8.7*
<i>Jones, F., care Col. Orr</i>	Fruitland	Present	7.3*	0.4*	9.1*	19.3*	6.9*
<i>Peace, J.</i>	Bartonville	0	0	1.3*	37.1*	9.5*	8.0*

* "Invisible injury" computed on the basis that $\frac{1}{3}$ of the injured fruit shows no sign of external injury.

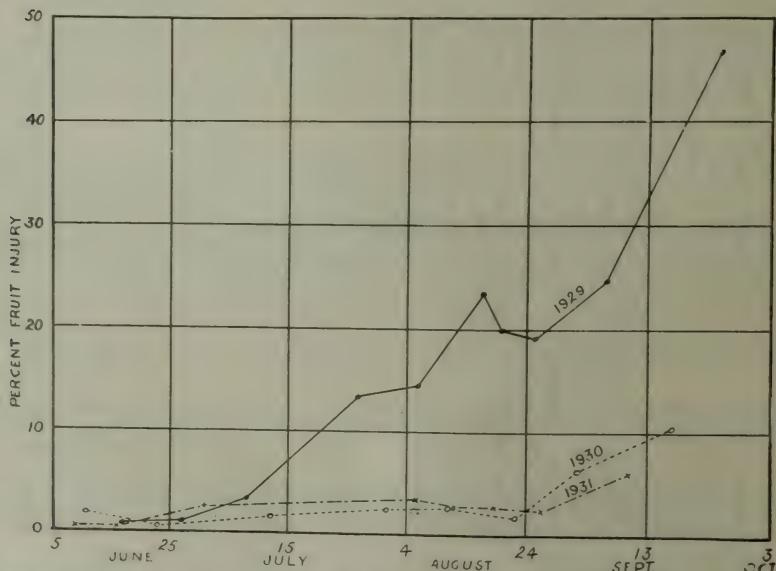
(†) One larva found in 1925.

The names of the owners of orchards in which observations have been made every year since 1926 are printed in italics.

THE REPORT OF THE
ORIENTAL FRUIT MOTH



Comparative seasonal populations of the moth as determined by bait traps in an Elberta orchard at St. Davids.



Seasonal injury as determined from random samples of Elberta peaches at St. Davids

The situation, for example, at Vineland Station is particularly intriguing. The insect was first discovered there in the fall of 1925; in 1926 the infestation was light; and from 1927 to 1931 the percentages of fruit injury on the variety Elberta were as follows: 2.8%; 3.4%; 3.5%; 2.4%; and 1.9%. Why has the history of the moth in this section been so different from that at St. Davids or along the Niagara river where in the Usher orchard, for instance, fruit injury increased from a trace in 1927 to 5 per cent. in 1928 and to 74 per cent. in 1929? Why have conditions east of St. Catharines been much more favourable for the insect than west of the city? We have yet to discover the answer to these questions. In connection with this, it should be mentioned that last year ecological studies were initiated in four sections of the peninsula with the view of attempting to ascertain what factors are responsible for the inconsistent behaviour of the moth.

By means of bait traps, egg counts, seasonal injury records and general observations, we have attempted to follow the seasonal history of the moth in orchards at St. Davids, and to determine with some degree of accuracy at what stage or stages population reductions have taken place. Conditions in 1927 were favourable for what may be considered a normal development of the insect, namely, a regular increase in the size of the broods with a consequent high percentage of fruit injury. In 1928, however, following the emergence of an unusually large spring brood of adults, there was, in place of the normal increment, a reduction in the size of the next *i.e.*, the first brood. The succeeding brood (the second) showed a normal increase, but, because of the setback received earlier in the season, it was smaller than the corresponding brood of 1927, and fruit injury was approximately 50 per cent. less. In 1929 there was again a fairly regular augmentation in the size of the summer broods, and, as was to be expected, a marked increase in the amount of fruit injury. 1930 was characterized by a reduced first brood, by a second brood only slightly larger than its predecessor, and by comparatively light fruit injury. 1931 was unique in that the diminution in the moth population, and a very pronounced one at that, took place after the emergence of the first brood and resulted in the dwindling of Elberta injury to less than 10 per cent. in most orchards east of St. Catharines. (We only know of one orchard in the whole fruit belt where injury to Elbertas reached serious proportions, namely the Armstrong orchard at St. Davids with 30.5 per cent. injury.)

I should like very much to be able to state that this most gratifying reduction in fruit injury had been brought about by the general adoption of artificial control measure, but, being more or less honest, I cannot do this. I should even feel content if we could give a fairly complete explanation in terms of natural control, but personally I do not think we can. In 1931 the introduced parasite *Macrocentrus*, the native larval parasites *Glypta* and *Cremastus*, the egg parasite *Trichogramma* and the predator *Chrysopa rufilabris*, played a major role in peach moth control; in 1930, biological factors, notably *Macrocentrus* and chrysopids were also of primary importance; but none of our records indicate that parasites played any considerable part in the reduction of 1928. Personally, I do not think we shall have any true conception of what has checked the peach moth infestation until we have learned something about the nature of the factors, most probably physical ones, which have undoubtedly supplemented the work of parasites and predators, and which have been largely instrumental in preventing the building up of big populations west of St. Catharines.

CHRYSOPIDS AS A FACTOR IN THE NATURAL CONTROL OF
THE ORIENTAL FRUIT MOTH

W. L. PUTMAN,

Dominion Entomological Laboratory, Vineland Station, Ontario

INTRODUCTION

During the summer of 1930 it was observed that large numbers of Oriental fruit moth eggs were being destroyed by some enemy which pierced the shell and sucked out their contents. The presence of many chrysopid larvae on the peach trees indicated that these might be responsible for the destruction of the eggs. These larvae were also a nuisance in the insectary at Vineland Station, getting on the twigs in the Oriental fruit moth oviposition cages and destroying large quantities of eggs. At the direction of Mr. W. A. Ross, the writer undertook some investigations on chrysopids at the Dominion Entomological Laboratory at Vineland Station, during part of the summer of 1930 and at St. Davids, Ont., during the summer of 1931.

Nine species of chrysopids were taken in peach orchards. Of these, only three were abundant, viz.:—*Chrysopa oculata*, *C. rufilabris* and *C. plorabunda*.

Each species occupies a more or less definite habitat. *Chrysopa oculata* is distinctly terrestrial, ovipositing and usually resting on low vegetation. As the larvae very rarely occur on trees it is of no value in the control of the Oriental fruit moth. *C. rufilabris* is the species of greatest importance. It is typically arboreal and all stages were found in large numbers on peach trees. *C. plorabunda* occupies a habitat intermediate between those of the previous species, being especially abundant on tall weeds and young trees, and consequently is of considerable, but secondary, importance as an enemy of the peach moth. The two latter species are the only ones of which the immature stages have been found on the trees. *C. oculata* is very strongly attracted by aphids; while *C. rufilabris* and *C. plorabunda* are attracted to a much lesser extent.

LIFE-HISTORY

As it was very difficult to get *C. rufilabris* or *C. plorabunda* to oviposit in captivity, the number of eggs laid by a female is not definitely known, but certainly exceeds 70. The life-history of both species may be summarized as follows:

Incubation period, 5.5. days; first instar larva, 4 days; 2nd instar, 4 days; 3rd instar, 4.5 days; complete larval period, 13 days; prepupal period, 3 days; pupal period, 8.5 days; complete life-history, 31 days. There were at least 2 and probably 3, complete generations, and possibly a partial 4th, this season.

By limiting the supply of food, the larval period can be greatly extended; in the case of *rufilabris* to over 30 days, or more than twice the normal period.

The larvae appeared to feed chiefly on small cicadellid nymphs, and to a slight extent on other small insects, but all such forms were generally scarce throughout the season.

FLUCTUATIONS IN NUMBERS IN ORCHARDS

DURING 1931.

The first specimen of *C. rufilabris* seen this year was taken on June 10, and the first egg was found the same day. After this date the number of adults increased rapidly, and from rough observations, remained more or less constant after July 1 until early in September. Egg deposition reached a peak between

July 2 and 16 and then fell off rapidly, although there was apparently no great decrease in the number of adults.

There are two possible causes for the decrease in the number of eggs; namely, parasitism and scarcity of food for the larvae. Egg parasitism did not appear until August, and never exceeded 12 per cent., while pupal parasitism was negligible. The scarcity of suitable food on peach trees has already been noted. It can, therefore, be safely concluded that the cause of the decline in numbers of eggs after the spring emergence was a deficiency of food for the larvae.

INFLUENCE OF APHIDS ON THE CHRYSOPID POPULATION.

At the beginning of these studies, it was believed that fluctuations in the number of aphids from year to year might influence the number of chrysopids and their attacks on peach moth eggs, because in 1930, the year in which their effect on peach moth eggs was first noticed, aphids were very scarce, while the previous year they had been very abundant. However, in 1931 chrysopids were again very abundant following a year of aphid scarcity, so it is doubtful if the prevalence of aphids has much effect on the numbers of *Chrysopa rufilabris* and *C. plorabunda* in the orchards.

RELATIONS TO THE ORIENTAL FRUIT MOTH.

Hungry chrysopid larvae in all three instars, and of both important species, readily ate peach moth eggs when these were supplied. The number of eggs consumed by a larva from hatching to maturity ranged from 377 to 679 in the case of *C. rufilabris* and 360 to 670 in the case of *plorabunda*, averaging 535 and 511 respectively. When the larvae were fed a limited number of eggs, fewer were required to bring them to maturity; in one case a *rufilabris* larva matured after eating only 262 eggs.

Under field conditions it was found to be almost impossible to distinguish sucked from hatched eggs. The only sucked eggs that can be definitely identified in the orchards are those not completely sucked or in which the head capsule of the embryo had formed. Many of these were found on the trees, but as they represent only part of those sucked by chrysopids, it is not possible to determine the total percentage destroyed.

While chrysopid larvae are of greatest importance as destroyers of the eggs, they also undoubtedly destroy many peach moth larvae. They carefully probe every cavity and crevice, and were observed to extract young larvae from deep within the axils of buds.

CONCLUSIONS

Chrysopids are an important factor in the natural control of the Oriental peach moth, although it is not possible to determine the actual percentage of eggs and larvae destroyed. The species responsible are *Chrysopa rufilabris* and to a lesser extent *C. plorabunda*. Other species may possibly assist to a limited extent, but *C. oculata* is of no importance. The number of chrysopids in the orchards is determined chiefly by the occurrence on the trees of suitable food for the larvae, and is little influenced by a general scarcity or abundance of aphids.

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CONTROL MEASURES FOR APPLE TREE BORERS

RAY HUTSON

Department of Entomology, Michigan State College.

During the past two seasons damage by flat-headed apple-tree borer, *Chrysobothris femorata*, has been reported to the Department of Entomology, Michigan State College, more frequently than for many years. Interspersed with these reports were cases which, in investigation, proved to be due to round-headed borers.

It was as a result of these inquiries that tests were instituted during the fall of 1930 and the spring of 1931 with the object of ascertaining the best methods of control for the borers already present in the trees. The various methods hitherto employed for the control of borers in apple trees were considered and the trial confined to two materials. The first of these was a paste made of raw cotton-seed oil mixed with calcium cyanide, after the method originated by Petch. The other material was a solution of one pound of paradichlorobenzene in two quarts of raw cottonseed oil. The latter material is the same one which has shown excellent results in tests against lesser peach-tree borer in various sections of the United States, after its efficacy had been discovered by specialists of the Bureau of Entomology. There seemed little doubt that the paradichlorobenzene solution in cottonseed oil would kill the borers. The only question seemed to be whether it would injure apple trees.

Tests of paradichlorobenzene-cottonseed oil and of calcium cyanide-cotton-seed oil were made in various orchards on trees ranging from two to twelve years old. In older trees the larger limbs were more often affected. Preliminary tests in the fall of 1930 with these materials indicated that either can be depended upon to kill borers. Experience in five orchard infestations and numerous casual plantings during the spring of 1931 bears out this conclusion and verifies the impression that the borers are killed without injury to the trees. Incidentally, the paradichlorobenzene-oil solution has been used successfully without injury to the trees in ornamental plantings infested with flat-headed borer. One case involving a cemetery development planting of around 200 acres landscaped with weeping birch, scarlet thorn, buck-thorn, and dogwood was treated for flat-headed borers with complete success from both control and lack of injury standpoints.

Time and method of application were studied in these same plantings. Spring and fall were selected for the applications, as at those times temperatures are not so high and the trees are in a less actively growing condition. As a check upon this assumption some trees were treated in summer. Trees receiving summer treatment have not shown any damage yet, but there seems little cause for treating trees at that time. Two methods of application were followed. One method, that of painting the material upon the darkened area indicating a burrow, requires no explanation beyond pointing out that the area was covered generously without, however, a surplus to run down over the bark of the trees. The other method consisted in the use of an unmodified "Alemite" grease gun of the "Zerk" type, such as is used in greasing automobiles, for making injections of the insecticides into the insect burrows. These "guns" are fitted with nozzles which have cone-shaped openings. In applying the materials under test the opening of the nozzle of a filled "gun" was placed over an opening leading into the burrow of the borer and pressure exerted. This forced the contents of the pressure-gun through the burrow to such an extent that openings several inches away sometimes provided evidence of the thoroughness of the application.

After trial of the two methods of application, it seems that for the flat-headed borer the painting method is preferable, although in neither case did we find any live borers, since it entails less trouble. In one infestation of round-headed borer,

Saperda cretata, in which alternate trees were treated by the two methods, there was a slight advantage in favor of the pressure gun, since an equally good kill was obtained with less material. It is necessary, however, when using the cyanide paste with the pressure gun, to use the powdered form of cyanide as the granular form settles into a mass which will not work through the nozzle.

OBSERVATIONS ON THE TRAPPING OF APPLE MAGGOT FLIES

J. MARSHALL

Dominion Entomological Laboratory, Annapolis Royal, N.S.

In a paper read last year before the Entomological Society of Ontario*, the writer indicated that ethyl malate, and to a lesser extent methyl malate, seemed chemotactically attractive to the apple maggot fly, *Rhagoletis pomonella* Walsh. Evidence of this lay in the fact that while a number of flies had been taken in pans baited with water solutions of these substances, none had been taken in pure water controls. Further work during the past season makes it desirable to have some additional observations made known lest that referred to above be misconstrued.

In the spring of 1931 it was learned that in Australia fruit flies were attracted to a proprietary insecticide called "Clensel" so a supply of this was procured for the purpose of determining if the apple maggot fly responded similarly. In July, when the flies became abundant, a large number of bait pans were exposed and some of these contained Clensel in water solution. It was soon noticeable that the Clensel pans were more effective in trapping apple maggot flies than any of the others so special tests were made. A small Wealthy tree bearing about 2 barrels of apples was chosen for one of these, and from its limbs were suspended 18 bait pans. Three of these contained water and the remaining 15, Clensel in water solution at concentrations of 1%, 5%, 10%, 25% and 50%; three pans for each concentration. In 11 days the 15 pans containing Clensel had trapped 914 apple maggot flies, a daily average of 83, or 5.5 per pan, while the controls had taken but two flies during the whole period. But in spite of this the apples were being marked with an ever increasing number of oviposition punctures and at the conclusion of the experiment flies were still numerous upon the tree. This is mentioned as testimony to the severity of the infestation and to anticipate the erroneous conclusion that Clensel is a powerful attractant for this fruit fly.

Subsequent to this test others were made wherein were used mixtures intended to simulate Clensel which is composed of fatty acids, free fat, essential oil, water, combined alkali, ammonia and glycerol. At the end of the flight period these inferences were drawn:

1. The odorous constituent of Clensel is probably oil of citronella or geraniol, presumably the former.
2. Neither oil of citronella nor geraniol was attractive in an olfactory sense to the apple maggot fly.
3. Potassium oleate and triethanolamine oleate aqueous solutions were as effective in trapping apple maggot flies as Clensel.
4. The flies apparently were not attracted by olfactory stimulus to Clensel or other soap solutions, but by visual stimulus which did not seem effective at distances greater than 12 inches.

*Notes on Chemotropic Responses of Certain Insects. Report Ent. Soc. Ont. 1930, pp. 83-84

5. Flies seemed to be attracted to pure water as well as to soap solutions but almost invariably escaped from it. On the other hand, they invariably drowned in a suitable soap solution owing to its low surface tension effecting immediate wetting. Undiluted Clensel trapped few flies for a scum soon formed upon it owing to the presence in it of drying oils.
6. Substances such as saponin, ethyl malate and methyl malate lowered the surface tension of the water sufficiently for the flies to be drowned when they entered it†.
7. Flies were trapped by darting directly into the liquid and not by walking down the side of the pan.
8. None of the tested substances trapped more than a few flies except when located less than 12 inches from a cluster of apples but under such circumstances a single pan containing 50% Clensel trapped no less than 79 apple maggot flies in two days.
9. Flies are generally found on or near groups of mature or immature apples but whether they arrive there as a result of visual or olfactory response, or both, is not yet learned.
10. It is very likely that the attractiveness of water surfaces is phototactic but it is possible that the flies might be chemopositive to water‡. This point is to be investigated in 1932.
11. Nearly twice as many flies were trapped in white graniteware pans as in grey ones of the same size, similarly situated and similarly baited.

Briefly, it seems that the mere presence of apple maggot flies in bait pans is not evidence of a response to odor—that factors such as color of pan, distance of pan from fruits, and color of liquid, are all important in inciting positive responses, and that only liquids or solutions with greater wetting power than water will prevent flies from escaping after having been attracted. Of course sticky materials are not considered here.

The writer wishes to acknowledge the assistance of F. T. Lord, of the Annapolis Royal Laboratory, who attended to the greater part of this work during the past season.

THE APPLE AND THORN SKELETONIZER

(*Simaethis pariana* Clerck)

L. CAESAR

Ontario Agricultural College, Guelph, Ontario.

So far as I know, the apple and thorn skeletonizer was first reported as present in Ontario in 1929, though its wide distribution that year indicated that it must have been here some years earlier. In 1930, owing probably to the effect of the very prolonged drought and hot weather, the insect did not seem to be much, if any, more abundant than in 1929. In 1931, however, there was a great increase so great that in some counties, especially in Welland and parts of Lincoln, whole orchards this fall had all their foliage brown and dead by the end of

†A tensiometer being unavailable this work was not pursued as far as might otherwise have been the case. It is presumed, however, that the malate solutions were effective in this way but no S. T. measurements were made.

‡Ripley and Hepburn (Ent. Mem. No. 7 Union So. Africa. 1931) imply that the Natal fruit fly, *Pierandrus rosa* Ksh., reacts chemopositively to water when thirsty.

September, just as if it had been scorched by fire. These orchards had all been unsprayed. Orchards which received the calyx spray, but no later one, had some injury, chiefly on the terminal growth. Orchards which received a special spray about July 1st for apple maggot were almost entirely free from injury, even from the late feeding caterpillars, some of which could be found up to the end of October.

HOW DOES THE INSECT WINTER?

It is claimed that this pest winters in the adult stage. I thought in 1929 that it did so, and was almost sure of it this year up to November 9th. My reasons for thinking so were as follows: On October 20th I received specimens of the moth for identification from Niagara-on-the-Lake and the sender stated that the moths were then present in myriads in the district. A few days later I received some more specimens from a lady near Georgetown who said the moths were very numerous in her home, and she was afraid they might be injurious in some way. On October 31st I inspected a row of nursery trees in the College orchard and collected from these 18 adults and saw fully as many more. The moths were on the leaves on the sunny side of the row and, if disturbed, fell or flew almost vertically down to the ground. Such large numbers of the moths so late in the season was therefore strong evidence that the insect must winter in the adult stage. But on November 9th I determined to see if there were many pupae still in the cocoons, and opened 100 of them. To my surprise I found that 59 still contained pupae, nearly all of which were alive. These had withstood a temperature of 26° F. So the question now is, does the insect winter in both the adult and pupal stage—a thing we should not expect—or does it winter in the adult stage alone and all the pupae perish from the low temperature of winter, or does it winter in the pupal stage alone and all the moths perish? If it winters in only one stage then here we have an insect that is poorly adapted to its surroundings, an insect of low biotic potential.

Since writing the above I brought into my room on November 11th about 50 leaves with cocoons on them. The room was fairly warm, especially during the day. The next morning a few adults appeared in the container and on the date of writing, November 14th, twenty-five adults have emerged. It seems remarkable if the insect winters in the pupal stage that adults should emerge so quickly when brought into a warm room. Yet we should keep in mind that had the autumn, especially October and November, been as cold as in the average year, many fewer moths would have emerged and many more pupae would have gone into winter alive.

Forty-one adults and at least an equal number of pupae, have been put into separate cages outside in as near normal conditions as possible, to determine the method of wintering.

THE STATUS OF LUBRICATING OIL SPRAYS IN ONTARIO

WILLIAM A. ROSS

Dominion Entomological Laboratory, Vineland Station, Ontario.

In this paper I wish to discuss briefly our experience with home-made lubricating oil sprays, which have now been used experimentally and commercially in Ontario for some eight years. My own observations on the sprays have been reinforced by replies to a questionnaire, which was mailed a few weeks ago to 54 fruit growers located in the fruit belt from the Niagara river to Bronte, and which, much to my astonishment, was filled in and returned by no less than 44 of them.

I should first of all make it clear that the only oil sprays I shall deal with are emulsions of very cheap lubricating oils with approximately the following characteristics:

Gravity at 60 degrees F., 24 to 26 A. P. I.

Viscosity at 100 degrees F., 170 to 220 seconds (Saybolt).

Volatility (loss at 105° to 110° C. after 4 hours), 0.41%.

The stock emulsion is prepared by pumping back into itself, under high pressure, a mixture of oil and weak bordeaux in the following proportions: 1 gallon lubricating oil; 2 ounces copper sulphate; 2 ounces fresh hydrated lime; 1 gallon water.

When we first recommended home-made oil sprays, I must confess I was not any too happy over the possibility of carelessly and improperly made emulsions causing serious injury, but I am glad to report that none of the anticipated troubles have cropped up. Due to the simplicity of the method of preparing the emulsions and also to the assistance, in the form of demonstrations, which the orchardists have received from entomologists and spray supervisors, very few growers—practically none—have experienced any difficulty in making satisfactory oil sprays.

PEAR PSYLLA CONTROL:—The statement has been made that lubricating oil sprays have proved to be the salvation of the pear growing industry in Ontario. Being canny by nature, I never indulge in or endorse such arresting statements, but I am prepared to say that oil sprays unquestionably have solved one of the fruit grower's most serious problems, namely the control of the pear psylla., *Psyllia pyricola* Forster.

Since our preliminary experiments* in 1924-25 indicated the possibilities of lubricating oil emulsions, these sprays have been used extensively every year in pear orchards, particularly in the Niagara and Burlington districts, and from this experience and also from further experimental work we have learned: (1) That by far the most economical and effective method of combatting the pear psylla is to apply a three per cent. lubricating oil spray in late March or early April after the adults have emerged from their winter quarters and before egg-laying has commenced; (2) That to be most effective the spraying must be completed prior to egg laying, because, in addition to killing many adults the oil, to a very marked extent, prevents egg deposition by the survivors. (This deterrent action unquestionably explains why lubricating oil sprays have given such clear cut results); (3) That, in order to obtain the maximum deterrent effect of the spray residue, the oil must be low in volatility; (4) That, in the average season and in isolated orchards, one application of oil by itself will give commercial control, but that in years of severe outbreaks it may be necessary to apply an extra spray or sprays of nicotine sulphate in late summer (In connection with this it is of interest to note that in two large pear orchards, which I have had under observation and which have been thoroughly sprayed at the proper time for seven years with a 3 per cent. emulsion, it has been necessary to apply an extra spray only in one season, namely 1927); (5) That it is necessary to apply the spray very thoroughly and in liberal quantities so that all parts of the tree will be coated; (6) That it is essential to spray all adjoining pear plantings, as the insect will disseminate itself through adjoining orchards, and hence may migrate from unsprayed, infested trees to trees on which it has been controlled; (7) That in order to facilitate pre-oviposition spraying, pear plantings should be tile drained where possible and that in all orchards, tiled or not tiled, good surface drainage should be provided so that no water will remain lying long on the ground. (Good drainage is most essential because in some seasons, e.g. 1927 and 1929, it is possible only in well-drained orchards to get on the land early enough with the spray outfit to secure satisfactory results.)

*"Miscellaneous Notes on the Pear Psylla Problem", Rept. Ent. Soc. Ont. 1924, pp. 80-84;
"Miscellaneous Notes on Lubricating Oil Sprays with Special Reference to Their Use for Pear Psylla Control", Rept. Ent. Soc., Ont., 1925, pp. 40-44.

EFFECT OF OIL SPRAYS ON PEAR TREES:—At the outset of the investigations on lubricating oil sprays there was a very definite fear that annual applications of oil would result in injury to the pear trees. I can recall the time when I would go into our experimental orchards in fear and trembling expecting the worst, but, as no deleterious effects appeared, I eventually got over this feeling. It can be stated definitely that, up to the present time, dormant applications of 3 per cent. oil sprays applied annually for 6, 7 and 8 consecutive years have caused absolutely no injury to healthy pear trees, nor have they in any instance reduced the crop of fruit. I specify healthy trees because of the probability that oil sprayed on dying wood may give it its final quietus. Not only have oil sprays caused no damage but by controlling the pear psylla they have been the means of reinvigorating and of bringing back into bearing trees, which, because of severe psylla injury, were no longer thrifty and profitable.

In 1926 we commenced an experiment with high concentrations of oil, in order to ascertain what type or types of injury oils might cause, and also to secure more precise information regarding the margin of safety there is in using the emulsions. The trees, in this experiment, have now received, every spring for six successive years, dormant applications of 10 and 20 per cent. concentrations respectively. The results of this work are briefly as follows:

The 10 per cent. concentration has caused no noticeable damage apart from retarding to a slight extent leaf bud development. This past summer, horticulturists, who examined the treated trees, could see no difference between them and the checks.

The 20 per cent. concentration caused no injury until the third year. That season, 1928, it delayed leaf bud growth to a very marked degree and fruit bud development to a very slight extent; it killed a considerable number of the leaf buds but, much to my surprise, none of the blossoms nor any of the wood. In connection with this killing of buds, the probabilities are that this damage would not have been so conspicuous if the trees had not been defoliated and consequently weakened the previous season, 1927, by a severe psylla infestation which had its genesis on neighbouring untreated trees. In 1929, 1930 and 1931, in addition to the expected marked delay in leaf bud development, we observed a conspicuous scarcity or absence of blossoms in the lower parts of the trees; we also noticed that the lenticels on the young wood were abnormally large; but we saw no definite indications of oil injury in the form of dead wood. This past summer, the only differences horticulturists noticed between the oil sprayed trees and the checks were that the former had somewhat more sucker growth and less fruit and that the fruit was largely confined to the upper parts of the trees. All the trees, experimental and checks, appeared to be equally vigorous.



Cross section of normal lenticel on 2 year pear wood.



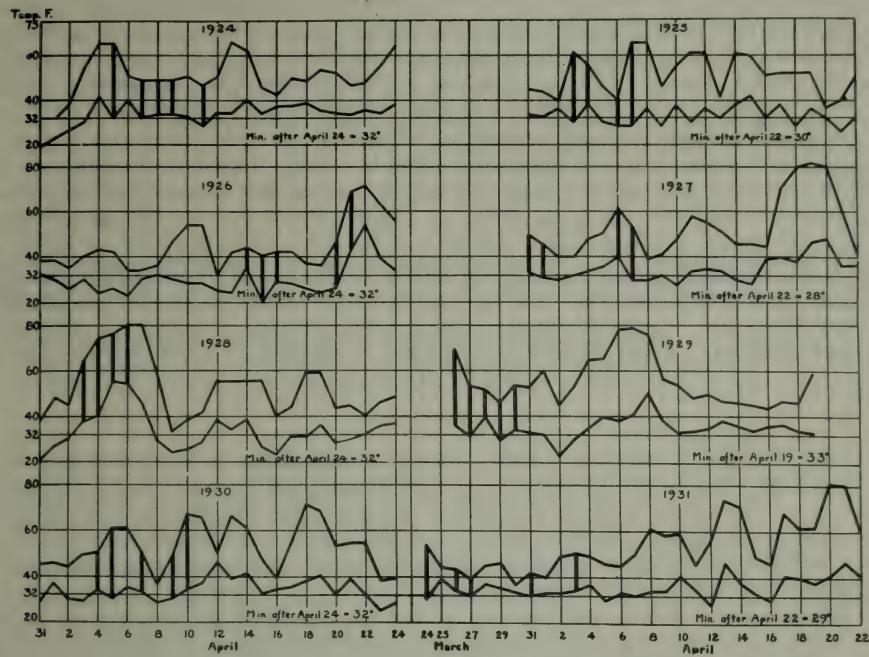
Lenticel on 2 year pear wood sprayed with 20% oil emulsion.



Cross section of 3 year pear wood sprayed with oil showing pseudo-lenticel—left, and flaking of phellem—centre and right.
(Photo by R. J. Willison)

Some of the young wood sprayed with the 20 per cent. concentration was sectioned and examined by Dr. Willison, St. Catharines Laboratory of Plant Pathology, and some of his findings are as follows:

There appears to be no penetration of the oil through the phloem, but the oil may penetrate into the sublenticular tissue and apparently only into this tissue, where it occurs in some, but not all intercellular spaces. The increased size of the lenticels is apparently due to the abnormal growth of sublenticular tissue. He also noticed that the oil causes some flaking of the phloem, which, particularly in three year old wood, may give rise to what he terms pseudo-lenticels. Less oil was observed beneath the pseudo-lenticels than beneath the true ones. The enlarged lenticels and the flaking of the phloem may be considered a form of spray injury, but it is so superficial that it is negligible in so far as the health of the tree is concerned.



OIL SPRAYING PEAR TREES

Maximum and minimum temperatures at Vineland Station before, during and after oil spraying. Heavy perpendiculars. . . dates of spraying.

To me it has been most reassuring to find that six successive applications of an oil spray, $3\frac{1}{3}$ times the strength of what we recommend, have been responsible for no commercial loss, and that an oil spray, approximately seven times the strength of what the pear grower uses, has so far caused no fatal or permanent injury.

It has been stated that oil sprays are likely to injure dormant trees if freezing temperatures follow immediately after the application. This most assuredly has not been our experience. During the past eight years the temperature dropped to 28°F. in 1924, 26°F. in 1925, 20°F. in 1926, 28°F. in 1927, 23°F. in 1928, 23°F. in 1929, 25°F. in 1930 and 28°F. in 1931, after some oil spraying had been done without giving rise to any damage. In order to give some idea of what temperature conditions are like at the time oil spraying for psylla is done, we have prepared a chart showing, for the period 1924-1931, the maximum and minimum temperatures recorded at Vineland Station and the dates of spraying an orchard situated about three miles from Vineland Station. It should be mentioned that none of the spraying took place when the temperature was very near, at or below freezing. This of course means that on some days only one or two tanks of oil spray would be put on around the warmer part of the day.

OIL SPRAYS AND FIRE-BLIGHT:—It is an interesting fact that, since the general adoption of oil sprays, fire blight has been of minor importance in pear orchards. Personally I am in no position even to express an opinion as to whether this is merely a coincidence, or whether the oil has actually had a restraining effect on the disease. There is no experimental evidence one way or the other, but, be that as it may, several orchardists are convinced that the oil emulsion is controlling pear blight. One grower with a very large acreage of pears at Burlington, and who has used oil for some eight years, writes as follows: "We cannot believe that it is only a coincidence that we have had no blight now for seven years.

Before using oil sprays our annual loss from blight was from 10 to 50 trees and countless branches, but since we have not averaged more than one or two branches annually." This same orchardist also points out that, on the assumption that the oil has and will continue to prevent serious outbreaks of blight, he and others have been using nitrate fertilizers liberally in pear orchards, something they would not have done when they were apprehensive about fire blight. A pear grower at Beamsville, who has sprayed with oil for five years, contributes this: "I can attribute the very marked decrease—I might almost say absence of blight—to nothing else." Another correspondent at Beamsville writes as follows: "Before using the oil spray we had severe attacks of blight on Bartletts, but since we adopted it blight has been of no consequence." This and all the other information I have been able to secure on the relationship of oil sprays to fire-blight is decidedly intriguing, but it proves nothing except the need of a joint investigation by pathologists and entomologists on the effect a coating of oil, which persists for a long time, has on hold-over cankers, on the bacterial exudate and on insect vectors.

BLACK CHERRY APHIS:—I have yet to come across a fruitgrower who is dubious about the efficacy of oil emulsions for pear psylla control, but I cannot say the same thing concerning the value of emulsions for the control of black cherry aphis, *Myzus cerasi* Fab. Replies to the query "Has the oil proved to be as satisfactory as nicotine sulphate in combatting the black cherry aphis?", varied from "far more so" to "absolutely no", most of the replies, however, being in the affirmative. Before attempting to explain this lack of unanimity, I shall refer to our own experience. Experiments with oil sprays in comparison with lime sulphur and nicotine sulphate were commenced in a Vineland Station sweet cherry orchard in 1925 and were carried on for three years. As a 3 per cent. lubricating oil spray proved to be every bit as effective as the much more costly lime sulphur (1-7) and nicotine sulphate (1-640) mixture, tests with the latter were discontinued, and from 1928 to 1931 the whole experimental orchard was sprayed annually with oil. Part and a substantial part of the planting has therefore been treated with oil for seven years, during which period the aphis was of minor importance in three, abundant in two and present in severe outbreak form in two years. The oil therefore was tried out under varied conditions of aphis intensity and, I am pleased to report, that every season an application, made when the most advanced buds were commencing to break, and supplemented by the removal and destruction in June of infested water sprouts, gave excellent commercial control.

I believe that lack of success with oil sprays is largely, if not wholly, due to the same factor responsible for failure to control the aphis with nicotine, namely lack of thoroughness. Experience has shown that it is not at all a simple matter to coat all the buds and all parts of the buds on large sweet cherry trees, and that this can be done only by using very liberal quantities of spray material, by spraying in a very systematic manner and by paying particular attention to the water sprouts on the trunks and main limbs. There is a possibility that, where spraying is not done any too carefully, nicotine may be somewhat more effective than the oil, but, be that as it may, our own experience and that of some of our best cherry growers, who have used oil from two to five years, demonstrates that a 3 per cent. oil emulsion is eminently satisfactory when properly applied.

EFFECT OF OIL ON CHERRY TREES:—No retardation of bud development and no injury, which could be definitely attributed to lubricating oil sprays, has been observed on sweet cherry trees, even on those which have been given an annual delayed dormant application of 3 per cent. oil spray for seven consecutive years.

EUROPEAN RED MITE:—The European red mite, *Paratetranychus pilosus* Fab., infests all our fruit trees, but, particularly in the Niagara peninsula, it is

primarily of importance as a serious pest of European plums, and for this reason our control studies have been largely confined to plum orchards. Investigations with oil sprays, commenced in 1926, have been continued up to this year, and have clearly demonstrated that the most satisfactory method of combatting the mite is to apply a three per cent. oil spray in spring before the buds burst. In seasons of mite abundance, the differences between trees which had and those which had not been treated with oil have always been very striking. To cite one experiment, in 1927 a Damson orchard was divided into four plots which were treated as follows:

- (1) Delayed dormant application of a 3 per cent. lubricating oil emulsion followed by two summer applications of bordeaux mixture.
- (2) 4 per cent. oil spray followed by bordeaux mixture.
- (3) Lime sulphur 1-7 followed by bordeaux mixture.
- (4) Lime sulphur 1-7 followed by lime sulphur 1-40.

In late May a rough census of the mite population was made in the experimental plots with the following results: Plot 1—12 mites per 100 spurs; Plot 2—5.7 mites per 100 spurs; Plots 3 and 4—7,144 mites per 100 spurs.

In late July the mite was much more abundant in 3 than in 4, but during August there was no appreciable difference between the two plots—in both characteristic injury was conspicuous and the mite was present in destructive numbers. On August 17 the difference between 1-2 and 3-4 was very striking. On the oil sprayed trees the foliage was dark green and the mite was still scarce, whereas in 3 and 4 the foliage was rusty-brown and the mite was so abundant that, following my recommendation, the trees in 3 and 4 were sprayed again with lime sulphur 1-50.

It should be mentioned that other experiments have shown no appreciable difference in toxicity between 3 per cent. oil in water and 3 per cent. diluted in bordeaux mixture; and also that in some seasons oil followed by summer sprays of lime sulphur is preferable, from the point of view of control, to oil followed by bordeaux sprays.

To refer to the questionnaire, all except one of the replies to the query "Has the oil proved to be effective against European red mite on plums?" were in the affirmative.

EFFECT OF OIL ON PLUM TREES:—So far I have seen no authentic case of oil injury to plum trees. In our experimental plots at Vineland, there has been a very considerable amount of winter injury in the form of dead branches, bark cankers and bark splitting on Reine Claudes, but fortunately no more on trees sprayed five or six years with oil than on those which have had no oil. In 1927 delayed dormant applications of 3 per cent. and 4 per cent. oil sprays on Damsons retarded blooming to a slight extent, but did not in any way affect the set of fruit or vigour of the trees.

SCALE INSECTS:—Generally speaking, since the winter of 1917-18, the San Jose scale, *Aspidiotus perniciosus* Comst., has been of quite minor importance in Ontario, and consequently we have no evidence of any particular value, so far, regarding the efficacy of home-made lubricating oil sprays in combatting this pest. However, in all probability we shall be able to make up for this deficiency this coming year, as there was a very marked increase in the scale population during 1931.

Only four of the men, who answered the questionnaire, had had experience with the San Jose scale in recent years—incidentally an interesting commentary

on the status of the insect. Three of them had controlled the scale with a three per cent. oil spray, but the fourth grower stated that, while applications of a three per cent. oil emulsion in 1930 and in 1931 had reduced the insect each year, he still noticed a considerable amount of scale on his Greening and Baldwin apples.

In 1926 we had an opportunity of testing oil sprays for the control of the cotty peach scale *Pulvinaria amygdali* Ckll., in a badly infested peach orchard at Port Dalhousie. Comparisons experiments with—(1) 3 per cent. oil spray in bordeaux mixture; (2) 4 per cent. oil spray in bordeaux mixture; (3) 3 per cent. oil spray in water; and (4) lime sulphur 1-7, were conducted in April before the buds showed any signs of bursting. In the case of 1 and 2, a 2-2-40 bordeaux mixture was used for the purpose of controlling peach leaf curl.

In early June, when the insects were rendered conspicuous by their egg sacs, population counts were made with the following results: average scale population per tree (1) 99; (2) 16; (3) 56.5; (4) 1208.5. In addition to this examination, observations made throughout the season clearly showed that the 4 per cent. oil spray had reduced the scale to absolute insignificance; that 3 per cent. oil spray diluted in water was somewhat more effective than when diluted in bordeaux mixture, and that lime sulphur 1-7 was practically useless. In September the scale was very abundant in 4 and the fruit was smutty; in 1 and 3 the insect was scarce, while in 2 it was quite hard to locate. The great scarcity of the insect on the oil sprayed trees, during the summer, lead me to surmise that the residue of oil on the wood had destroyed many newly hatched nymphs.

APPLE LEAF ROLLERS:—Leaf roller control experiments conducted during the past three years by my colleague, Mr. J. A. Hall, in Norfolk county have shown that lubricating oil sprays are very effective against the eggs of the two most common species, *Archips argyrospila* and *A. semiferana*, and that from the points of view of economy, safety and effectiveness a 6 per cent. concentration is most satisfactory.

EFFECT OF OIL SPRAYS ON APPLE TREES:—Our experience with oil sprays for leaf roller control demonstrates that to be safe 6 per cent. and 8 per cent. concentrations should be applied before the buds show green. In 1929 unseasonal weather conditions started the buds very early, and as a consequence applications of 8 per cent. oil sprays were made when the buds were showing green. This treatment produced a very marked and most alarming looking retardation of leaf bud development, and it killed a small percentage of the fruit buds. The somewhat striken appearance of the trees, and the effect this had on our nerves proved, however, to be the worst part of the damage, because that same season the trees outgrew the injury and yielded a normal crop. It is of interest to note that lighter and more volatile oils than those we recommend, caused much more injury that year. Fruit bud counts made on the lower limbs of trees sprayed with (1) a recommended oil, 8 per cent. and (2) a light, volatile oil,* 8 per cent. gave the following data:

	1.	2.
Fruit bud killing on McIntosh.....	1.5%	50%
Fruit bud killing on Yellow Transparent.....	6.0%	55%
Fruit bud killing on Greening.....	0.0%	1%

Since 1928 a block of apple trees at Vineland has been sprayed annually at the delayed dormant stage with a 3 per cent lubricating oil spray diluted in bordeaux mixture, and, so far, this has not produced any retardation of bud development nor has it killed any wood or buds. The oil has caused some singeing of the leaves, comparable with that caused by lime sulphur 1-7, and where followed by

*Imperial Diamond Paraffin Oil—viscosity at 100°F., 85.95 seconds (Saybolt).

a "pink application" of lime sulphur 1-40, the oil has given rise to severe foliage injury in the form of burning, dwarfing and curling. However, our experiments have shown that the latter injury may be largely prevented by using the aluminum sulphate—lime sulphur mixture in place of lime sulphur for the pre-blossom application. In this connection I should also mention that our experience with higher concentrations of oil for leaf roller control has also shown that it is safer to use the aluminum sulphate mix than lime sulphur for the "pink spray" on oil sprayed trees.

In conclusion it may be said that in Ontario annual spraying with home-made lubricating oil emulsions has been largely restricted to fruit districts where pears, sweet cherries and European plums are grown on a commercial scale, and that the oil sprays have been used chiefly for the control of the pear psylla, the black cherry aphid and the European red mite.

THE BROWN-HEADED SPRUCE SAWFLY

Pachynematus ocreatus (Harr.) Marlatt*

A. V. MITCHENER

University of Manitoba, Winnipeg, Manitoba.

The brown-headed spruce sawfly *Pachynematus ocreatus* was first described by Harrington (1) as *Nematus ocreatus* from a single female specimen captured near Hull, Quebec on May 16, 1886. In 1896 Marlatt (2) redescribed Harrington's type specimen and placed it in the genus *Pachynematus* where it still remains. Both genera are European, *Nematus* having been established by Jurine in 1807 and *Pachynematus* by Konow in 1890. Viereck (3) included the species in his key to the females of the genus *Pachynematus*. Short references by King, McMillan and Stewart (4) and Mitchener and Criddle (5) (6) and (7) indicate that this species is injurious to white spruce *Picea canadensis* (Mill.) B. S. P.) No other reference to this insect has been noted in the literature.

The following notes are based upon observations made during the summers of 1928, 1929, 1930 and 1931, both in a screened insectary and upon the campus of Manitoba Agricultural College where these sawflies occurred. The only host observed for the larvae was white spruce which had been transplanted to lawns and windbreaks. New growth of the current season only was eaten by the larvae. Where the larvae were abundant on a tree many of the new needles were devoured. This interfered seriously with the symmetrical growth of the trees infested, especially when the trees were attacked several years in succession as was usually the case. This insect has been found at Basswood, Grandview, Inwood, Morden, St. Vital and Winnipeg in Manitoba.

DESCRIPTIONS

Adult Male.—Four pinned specimens ranged from 5.5. mm. to 6.5 mm. and averaged 6 mm.; antennae filiform, black, segments 4 and 5 equal and slightly longer than 3; thorax black; basal part of abdomen brownish black, middle segments brown and terminal segments brownish black, the lighter middle segments appearing as a band around the abdomen; stigma dark brown.

Adult female.—References have been made already to two descriptions of the female. Fourteen specimens in the M. A. C. collections checked closely with Marlatt's description. These ranged from 6 mm. to 9 mm. long with an average length of 8 mm.

*Tenthredinidae, Hymenoptera.

Eggs.—The eggs (Fig. 1) were yellowish and oval and were attached near the bases of the developing needles of the current season's growth. One egg only was attached to each needle, but many eggs were deposited usually on each unit of growth. Five eggs were measured and these averaged 1.12 mm. in length and .50 mm. in width.

Larvae.—The larvae (Fig. 2) were approximately 13-15 mm. in length when fully grown. The head was brown. Three pairs of narrow dark stripes extended the full length of the thorax and abdomen. The two dark stripes in each pair were separated by a lighter stripe of about equal width. The pairs of dark stripes were separated by wider light stripes. The middle pair of dark stripes was dorsal. On each side of the larva was a broken band of dark pigment. The legs were marked with dark brown to black and the claws were of the same color. The seven pairs of prolegs were light in color. The end of the abdomen was characteristically curled underneath.

Cocoons.—The cocoons (Fig. 3) were approximately 10 mm. long and were dark in color. One end was rounded while the other was slightly more pointed. The adult cut its way out through the rounded end of the cocoon by means of its mandibles. In one instance observed the cutting operation could be heard distinctly at one foot from the cocoon.

BIOLOGY

Adult sawflies made their appearance from June 4 to June 8, 1929 and from May 30 to June 8, 1930. First adults were observed on May 28, 1931. The records for 1930 included the emergence of 30 ♂ and 48 ♀ the cocoons of which had been kept in a screened insectary from 1929. From records obtained in 1929 and 1930 the preoviposition period for the females was from one to two days. Counts of eggs in the ovaries of 17 females averaged 43.6 eggs per female, the range being from 23 to 69 eggs per female. The time spent in the egg stage by 172 larvae in 1929, 1930 and 1931 averaged 7.2 days. The time varied from 7 to 9 days. Eggs hatched over the period June 8 to June 17 during the three years. During 1929 and 1930 one hundred and twenty-six larvae under observation ultimately formed cocoons. These averaged 28.8 days in the larval stage which varied from 26 to 30 days, most requiring 29 days. This active larval period began as early as June 8 and was completed as late as July 15. The larvae fed upon the new growth exclusively. They always headed outward from the stem when feeding upon the tender needles. Any outer portions of the needles cut off while feeding, fell to the ground. As frequently many eggs were laid on each terminal unit of new growth the resulting larvae ate away all the new needles. When larval growth was completed each larva descended and formed a cocoon in the litter on the ground under the tree, on the surface of the ground or a short distance below the surface of the soil. The larvae remained in these cocoons until the following May when pupation took place. In 1931 six cocoons which were opened on May 16 each contained a larva. On May 18 eight more cocoons were opened from the same collection and of these, 3 contained larvae and 5 pupae. On May 21, 4 cocoons examined contained 2 pupae and 2 adults. The evidence suggests that the pupal stage is of short duration and that the adults probably remain in the cocoons a few days until favorable weather conditions occur when they emerge. There is one brood per year.

CONTROL

The larvae were easily killed with arsenate of lime applied either as a spray or as a dust. Care should be taken to see that all new shoots are thoroughly covered with the arsenical which should be applied while the larvae are small, before

serious damage has been done. This would be as soon as the newgrowth is sufficiently advanced to hold the spray or dust. The application of an arsenical to the previous season's growth is useless as the larvae do not feed upon these needles. In most years the control should be applied by June 15.

SUMMARY

The brown-headed spruce sawfly *Pachynematus ocreatus* (Harr.) Marlatt occurs in Manitoba in injurious numbers on transplanted white spruce. The winter is passed as larvae within cocoons at the bases of the infested trees. In late May pupation takes place and by June 1 the adults begin to emerge. One or two days after emergence the females begin to lay their eggs on the needles of the current season's growth. The eggs hatch in approximately 7 days and the larvae feed for about 29 days before descending and forming cocoons under the trees. There is one brood each year. The larvae are controlled easily with arsenate of lime. Descriptions are given of the adult males, the eggs the larvae and the cocoons.

ACKNOWLEDGMENTS

The writer acknowledges gratefully the assistance of Dr. William Middleton, Bureau of Entomology, U. S. Department of Agriculture, Washington, and Dr. J. M. Swaine, Entomological Branch, Department of Agriculture, Ottawa for favors in connection with the determination of the species. To the former and also to Mr. G. Stuart Walley, Entomological Branch, Department of Agriculture, Ottawa, thanks are due for searching available literature for references to this species.

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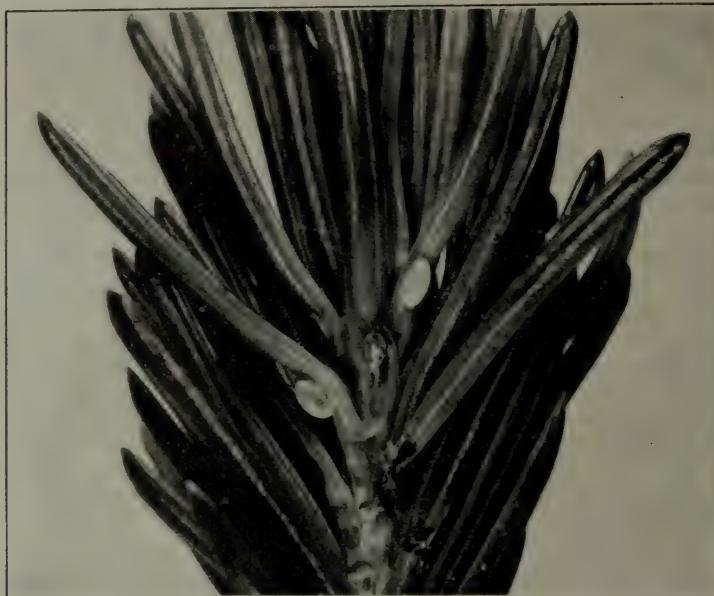


Fig. 1.—Two eggs of *Pachynematus ocreatus* on new growth. Approx. 5 diameters.

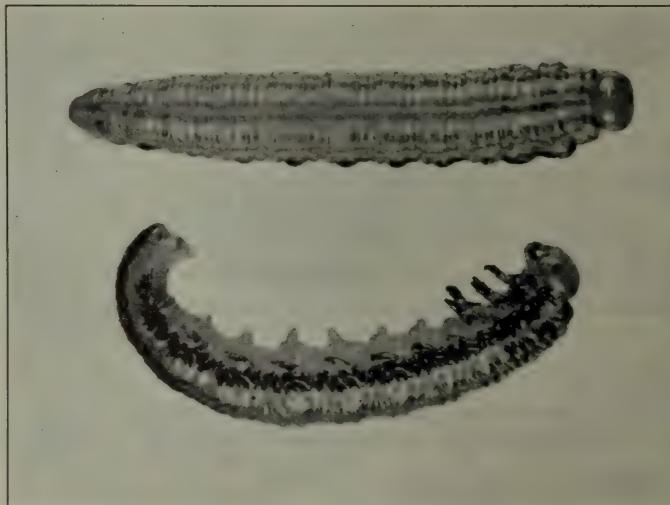


Fig. 2.—Dorsal and lateral views of larvæ of *Pachymenatus ocreatus* showing markings. Approx. 5 diameters.



Fig. 3.—Two cocoons enclosing larvæ of *Pachynematus ocreatus*. Left free from adhering particles of earth. Right with particles still attached to cocoon. Approx. 5 diameters.

***DREYFUSIA PICEAE (RATZ.) AND ITS RELATION TO "GOUT DISEASE" IN BALSAM FIR.**

By E. R. BALCH

Department of Agriculture, Entomological Branch, Ottawa

For some years an abnormal condition has been noticed developing on balsam fir in Nova Scotia. It consists of a swelling of the twigs, a killing of the buds and a gradual dying back of the branches. The tops of the trees are generally most seriously affected and these are often killed back one or two feet, or lean over and cause an "umbrella top". Typical cases have a stunted, gnarled appearance, with rapid taper of the stem.

It had been generally thought that this was due to a fungus, but no pathogen could be isolated by the pathologists who studied it. In the fall of 1930, however, a number of trees were examined by the writer, to see whether an insect might possibly be the cause. It was discovered that small numbers of the larvae of *Dreyfusia piceae* were invariably associated with the swellings in their earlier stages. In the later stages, remains of the insect were generally found under the old bud scales.

As a result, this summer some attention has been given to the insect and its association with the disease. More intensive study is planned, but the following preliminary observations may be of interest now, owing to the unusual nature of the injury and its importance as a factor of deterioration and destruction in balsam stands.

The distribution of the insect east of the St. Lawrence in Canada is confined to Nova Scotia and the southern part of New Brunswick, and it has not yet been found north of a line drawn from Shediae Point to Fredericton and down to Lawrence. Reports of its occurrence in other parts of Canada will be appreciated.

*Annand (1) reduces the genera of the Adelginae to *Adelges* and *Pineus*. This places *Dreyfusia* in the genus *Adelges*. While such simplification seems justified the name *Dreyfusia* is retained here owing to its general use, almost as a common name.

Dreyfusia piceae is an Adelgid, apparently introduced from Europe. It was reported, however, in New England in 1910 (4) and has probably been in Nova Scotia for twenty years or more. It has not been studied in America, although it has been observed in California and partially described by Annand. (1). It has, however, been studied by several workers in different parts of Europe, where its power of forming swellings at the buds and nodes has been noted on certain species of fir, although nothing comparable to the condition of the fir stands in Nova Scotia has been described.



Top of a 35-foot balsam fir affected by "gout". (Note "recovery" of branch in background which later died. Branch on right is producing normal shoots.)

LIFE-HISTORY

The first stage sistens larvae are black, oval and flattened, with a fringe of wax plates around the edge and down the medio-dorsal line. They are found wintering on the bark of the stem, branches, or twigs, in the latter case generally at the base of the buds or beneath the old scales at the first node. The body is only .4 mm. long but the stylets, which are thrust into the cortical tissue, are often 2 mm. in length.

Development begins in the early spring. After the first moult the insect becomes more hemispherical and the position and form of the wax pores are radically changed. A complete covering of wax threads develops and the infestation becomes more conspicuous owing to these wool-like masses. In the fourth stage an ovipositor appears and egg-laying commences.

As many as 168 eggs have been observed from one female, but the average is probably somewhat less than this. Those which are laid first commence to hatch before the egg mass is completed.

Some of the first eggs to hatch, under laboratory conditions, produced progrediens larvae which crawled to the needles and developed after four moults into winged forms. A few have also been observed in the field. This seems, however, to be a rudimentary generation as it has not yet been found to reproduce either on spruce or fir. The majority of the eggs produce larvae similar to the

over-wintering form. Some of these (hemosistentes) settle down and remain as larvae until next spring. Others, (aestivosistentes) after a brief period of rest, begin to develop and produce eggs the same summer. The number of eggs laid by this generation is smaller, averaging perhaps not more than thirty. These produce larvae of the sistens type which overwinter. There may be a third generation under certain circumstances but only two, have been observed this season. As far as the progress of the infestation is concerned it seems to be dependent on these apterous, parthenogenetic forms on *Abies*. Dispersion probably takes place through the transportation of the eggs and newly hatched larvae by animals, birds and wind, aided possibly by the "wool" of the adults.

ASSOCIATION WITH DREYFUSIA NUSSLINI

In Europe, this species is found generally in association with *Dreyfusia nusslini* Börner, with which it has frequently been confused. The two species have been separated on morphological as well as biological grounds, but the former distinctions are slight and can only be recognized by careful microscopic preparation. The chief biological difference seems to lie in a greater preference of *nusslini* for the twigs, and in the production by the latter of a considerable number of a progrediens form which settles on the needles and of a sexual generation on *Picea orientalis*. Considerable damage to *Abies pectinata* and other firs has been reported in Europe as due to *nusslini*, which causes the leaders and twigs to wither. *Dreyfusia piceae* is considered of less importance, although it does produce a swelling at the buds and nodes and is thought to kill trees by attacking the stem (3 and 5). *Nusslini* apparently does not cause swellings in Europe, but Dr. Chrystal of Oxford University has recently sent me a photograph of a shoot of *Abies grandis* in which he produced swellings by infesting it with this species.

I have as yet been unable to find *nusslini* in Nova Scotia. All those individuals which have been microscopically examined have proved to be *piceae*. Nor has any attack on the needles been found other than that mentioned above.

EFFECT ON THE TREE

Artificial infestations have been successfully made on a number of small trees, both in the laboratory and in the forest. Five species of *Abies* have been used: *balsamea*, *pectinata*, *nobilis*, *concolor* and *grandis*, and the larvae have established themselves on all of them. Observations have also been made throughout the summer on naturally infested trees, many of which have been cut and analyzed. Sections have been made of affected tissue. Without going into details at present, the following general conclusions have been arrived at.

PARTS ATTACKED.—All sizes and ages of trees are attacked. The insects may be concentrated on the stem without affecting the twigs or vice versa. They may be found on all parts of the bark above ground.

Larvae from eggs taken from the stem of a large tree and transferred to the twigs will settle freely, and apparently by preference, on the ends and at the bases of the new shoots. No explanation is offered as yet for the fact that some trees are attacked only on the stem, others only on the twigs.

EFFECT ON TWIGS.—With the exception of *Abies pectinata*, all the above species of fir produce abnormal growth of the cortical tissues and apparently also of the wood, wherever feeding takes place. This seems to result from a more or less local stimulation. The cells of the cortical parenchyma are increased in size and number; there is an enlargement of the wood ring, with a thickening of the tracheid walls, and a swelling results. At some points the formation of wood on the new shoots is prevented and "pits" are found extending through the xylem ring into the pith.

Where a number of the larvae settle on the buds, the latter frequently fail to grow the following year. If they do, the growth is reduced and the shoot depressed. When the buds fail the twig continues to grow in diameter but not in length, and this increases the swollen appearance. Eventually, the twig dies back slowly.

After the first year, more or less spherical pockets of a purplish colour form in the parenchyma of the cortex. These consist apparently of broken down parenchyma cells surrounded by a secondary periderm of purplish cells. The latter form a sort of abscission layer and the pockets can be lifted out intact. Possibly this is simply the natural defensive reaction of the plant in an attempt to segregate injured tissue.

The degree of swelling is not in direct proportion to the number of insects. It varies with individual trees and on different parts of the tree. Apparently the vigour of the infested part has something to do with it. One larva inserting its stylets in a growing shoot may cause a very noticeable swelling in one season even though it remain dormant. A large number of larvae, on the other hand, often appears to reduce gall formation, possibly by too rapid extraction of the sap.

As the tree grows, some of the insects remain on the nodes; others migrate to the new shoots. After killing the buds they may continue to increase in numbers and spread along the internodes.

Sometimes the chermes on a tree will all die and the latter will recover and produce new growth free from swellings. Continued attack generally results in slow death.

EFFECT ON STEM.—In the case of the stem attack the larvae will be found concentrating in crevices, at lenticels, and under lichens and mosses. The effect of the feeding on the cortex is less obvious but the bark often acquires a typical, roughened appearance from a slight swelling in the neighbourhood of the lenticels.

The wood also appears to be affected. Wherever any number of the chermes is found, the surface of the wood beneath the cambium will be somewhat dark in colour. When the infestation is heavy, the annual ring appears to be enlarged and the tracheids take on a similar form to those of "compression wood". They are rounded and thick-walled, with the lumen often very considerably reduced.

The bark of heavily infested stems develops superficial areas of dead tissue beneath the epidermis. These are separated from the green cortex by a periderm similar to that mentioned above. Sometimes in dying trees these areas will be found extending as far as the cambium but this is not a general condition. They exude considerable amounts of resin. This is added to by the punctures of *Pissodes dulius* Rand.

Trees may withstand a moderate stem attack for a number of years, but a great many in Nova Scotia and southern New Brunswick are dying. No attempt will be made here to estimate the factors contributing to the death of these trees, but the initial cause is, without doubt, the attack of *Dreyfusia*.

RELATION TO GOUT

The above observations are a partial explanation of "gout". The symptoms of this condition, as they are known to all Nova Scotia foresters, are beyond question associated with the attack of *Dreyfusia piceae*. The exact role of the insect, however, is as yet not known and cannot be satisfactorily discussed until more experimental and histological study has been completed. It is possible that it is a carrier of a fungus or bacterial disease. Such fungi as have been found in

the affected tissues, however, are apparently secondary. A virus disease is also possible but so far the evidence is against this.

The injection of some toxin, enzyme, or stimulating substance seems more probable. The Adelgids are a gall-forming group, although their gall-forming proclivities have so far been observed only on the primary hosts, of the genus *Picea*. It seems probable that "gout" is the result of a stimulation similar to that which produces the galls on spruce. The solution of the problem might throw some light on the whole question of the chemical or physical forces controlling the activity of the cambium in the formation of compression wood.

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Fig. 1.—Stand being killed by "stem attack". The two trees on extreme right and left already killed, other four dying.

THE PARASITES OF THE ORIENTAL FRUIT MOTH

(Laspeyresia molesta Busck.) IN ONTARIO 1931.

By W. E. VAN STEENBURGH

Dominion Parasite Laboratory, Entomological Branch, Belleville, Ont.

The present season has shown a marked increase in the abundance of parasites attacking the Oriental Fruit Moth and, mainly due to their destructive influence, a reduction has been made in the damage effected by the pest. This increased activity on the part of the parasites occurred in all the peach growing areas of the Province, and many native parasites, which heretofore appeared in small numbers, became abundant. *Macrocentrus ancylivora* Rohwer, an introduced species from New Jersey, was recovered from all the 1928 and 1929 colonization centres, and in the St.-Davids-Queenston-Niagara-on-the-Lake area was an important factor of control.

Trichogramma minutum Riley

This parasite was first found parasitizing Oriental Fruit Moth eggs during the last week of June, and this record represents its earliest appearance on this host since observations were begun in 1928. On July 9, two large orchards near St. Davids showed respectively 20.5 per cent. and 42.5 per cent. egg destruction. Thereafter during the season *Trichogramma* was constantly present in the peach orchards, but showed a slight decline in the percentage of eggs it destroyed as the host became less numerous.

The experimental releases of laboratory bred *Trichogramma* consisted of 3,810,000 individuals and were conducted in much the same manner as in 1930, except that all orchards within a certain area were treated. It was felt that in this way the *Trichogramma* population of the experimental block would be uniformly increased and that the dispersal between orchards would tend to equalize each other. In addition to the laboratory bred material, a collection was made in Prince Edward County of parasitized *Sialis* eggs and approximately 5,000,000 individuals of native dark *Trichogramma*, secured from this material, were liberated in orchards adjoining the block.

In changing to the block liberation system, it was with a view to continuing liberations annually according to a definite plan until we have demonstrated the value of *Trichogramma* liberations as a factor in the commercial control of the Oriental Fruit Moth. It was not possible to obtain conclusive results during the present season due, in part, to the small numbers of parasites available for liberation, and also to the scarcity of host eggs brought about by weather conditions and the operation of other biological control agencies.

Laboratory experiments have demonstrated a marked difference in reaction of the blonde and dark strains to different degrees of temperature and humidity, the blonde strain being more active and prolific at lower temperatures, while the dark strain shows greater activity at higher temperatures. The blonde strain also lives much longer under all conditions than the dark strain. Liberations made prior to this year were largely of the dark strain, but, utilizing the above knowledge, the blonde strain will receive greater attention in future.

COLONIZATIONS OF *Macrocentrus ancylivora* Rohwer

No additional introductions of this species were undertaken during the past season and all new colonies were established from reared and recovered material. Breeding experiments using the Strawberry Leaf Roller (*Ancylis comptana* Froel.) as host, were conducted at both St. Davids and Belleville, and yielded a

total of 1223 ♂ and 1895 ♀, and an additional 769 ♂ and 809 ♀ were secured from the collections of infested twigs and fruit. From this material liberations were made as follows:

	♂	♀
Stamford.....	214	283
Port Wellar.....	672	791
St. Catharines.....	263	343
Port Dalhousie.....	97	127
Jordan.....	14	32
Grimsby.....	37	109
Winona.....	15	73
Fruitland.....	20	72
Stoney Creek.....	179	287
Leamington.....	37	81

In all, a total of 3,746 individuals was released. The remainder of the *Macrocentrus* material was pinned for identification purposes, represents a natural mortality, or was used in experimental breeding.

No colonizations were made in the St. Davids-Queenston-Niagara-on-the-Lake districts, since it seemed advisable to study the rate of establishment of the species under local conditions at the 1929 and 1930 colonization points, therefore, all recoveries from this area represent the progeny of over-wintering stock.

LARVAL PARASITES

Collections of infested twigs were taken, as in previous years, during the 1st and 2nd larval generations of the moth from the various peach growing districts of the Province, and forwarded to Belleville, where the larvae were individually reared. Records were also kept of the larval parasites secured from collections of June drops gathered at St. Davids.

The following records include the introduced species, *Macrocentrus ancyliivora* Rohwer, which has now assumed the role of an important control factor.

The first generation twig collection yielded 4,552 emergents, of which the following were larval parasites:

<i>Macrocentrus ancyliivora</i> Rohwer.....	667
<i>Glypta rufiscutellaris</i> Cress.....	27
<i>Cremastus minor</i> Cush.....	310
<i>Diocetes oblitteratus</i> (Cress.).....	39
<i>Ascogaster carpocapsae</i> (Vier).....	15
<i>Lixophaga plumbea</i> Ald.....	4
<i>Macrocentrus</i> sp. (Black head and abdomen).....	2
<i>Elephantocera greeni</i> Town.....	1
<i>Meteorus</i> sp.....	1
<i>Epiurus</i> sp.....	1
<i>Cremastus forbesii</i> Weed.....	1

Thus a per centage of 14.6 of the emergents was the introduced species and 8.8 per cent. native paraistes.

A total of 2,971 emergents was obtained from the larvae feeding in the June drops. The following parasites were secured:

<i>Macrocentrus ancyliivora</i> Rohwer.....	68
<i>Glypta rufiscutellaris</i> Cress.....	35
<i>Cremastus minor</i> Cush.....	218
<i>Lixophaga plumbea</i> Ald.....	1
<i>Diocetes oblitteratus</i> (Cress.).....	13
* <i>Calliephialtes grapholitiae</i> (Cress.).....	9
<i>Cremastus forbesii</i> Weed.....	1
Unidentified.....	2

**Calliephialtes grapholitiae* Cress attacks the full grown larva in the spin-up and may utilize mature larvae in young fruit in the earlier part of the season.

The drops were secured in an old bearing orchard, and of the emergents 1.7 per cent. were *Macrocentrus ancylivora* Rohwer, and 6.9 per cent. native species.

The percentage of larval parasitism secured in the twigs by collection points for the first generation was as follows:

	<i>M. ancylivora</i>	<i>G. rufiscutellaris</i>	<i>G. Minor</i>	Others	Total
1. St. Davids.....	14.0	.8	8.9	2.1	25.8
2. Between St. Davids and Virgil	25.4	1.1	11.0	1.7	39.2
3. Virgil.....	22.3	.2	7.3	.2	30.0
4. Queenston.....	23.9	.2	7.5	.2	31.8
5. Niagara-on-the-Lake.....	20.7	.3	5.8	.....	26.8
6. Port Wellar.....	2.8	.3	.9	.3	4.3
7. St. Catharines.....	5.0	.....	.....	.....	5.0
8. Stamford.....	.....	.4	1.8	1.2	3.4
9. Fonthill.....	.....	2.4	1.6	5.6	9.6
10. Cedar Springs.....	10.9	.....	.....	2.7	13.6
11. Leamington.....	.....	.6	1.2	2.4	4.2

The first five stations represent the greater number of collection points and also the area of oldest infestation of the moth. It was in this area that the large colonizations of *Macrocentrus ancylivora* Rohwer were made. It will be seen from the records that for this generation *Macrocentrus* was of greater importance than the combined native species of parasites.

The second generation collections of larvae from the infested twigs and reared at the Belleville Laboratory yielded 2,694 emergents, of which, the following were parasites:

<i>Macrocentrus ancylivora</i> Rohwer.....	559
<i>Glypta rufiscutellaris</i> Cress.....	926
<i>Cremastus minor</i> Cush.....	840
<i>Cremastus forbesii</i> Weed.....	17
<i>Diocles oblitteratus</i> (Cress.).....	6
<i>Lixophaga plumbea</i> Ald.....	5
<i>Elephantocera greeni</i> Town.....	1
<i>Meteorus</i> sp.....	1

Of all the emergents secured during this series of collections, 20.7 per cent. were *Macrocentrus ancylivora* Rohwer, and 67.3 per cent. native species. It should be pointed out that this relative reduction in numbers of *Macrocentrus ancylivora* does not indicate a reduction in population of this species, but an increase of the native forms.

The percentage of larval parasitism in the second generation, as secured from collections of infested twigs at the various points, was as follows:

	<i>M. ancylivora</i>	<i>G. rufiscutellaris</i>	<i>C. Minor</i>	Others	Total
1. St. Davids.....	25.0	21.7	34.5	1.0	82.2
2. Between St. Davids and Virgil.....	26.4	7.3	61.9	.....	95.6
3. Virgil.....	27.0	18.6	48.4	.7	94.7
4. Queenston.....	36.4	23.5	25.5	.8	86.2
5. Niagara-on-the-Lake.....	15.5	43.5	27.0	1.0	87.0
6. Port Wellar.....	.....	72.2	9.2	1.7	83.1
7. St. Catharines.....	13.3	56.2	24.7	3.8	98.0
8. Stamford.....	2.7	75.3	14.3	1.2	83.5
9. Fonthill.....	1.5	80.0	.7	3.7	85.9
10. Cedar Springs.....	28.6	57.1	14.3	.....	100.00
11. Leamington.....	9.6	67.1	13.7	1.4	91.8
12. Grimsby.....	8.3	83.3	.....	.....	91.6
13. Winona.....	5.1	88.1	1.7	.....	94.9
14. Fruitland.....	3.7	94.4	1.9	.....	100.0

There was a phenomenal increase in the numbers of *Glypta rufiscutellaris* Cress. and *Cremastus minor* Cush. parasitizing the larvae of the second generation, which suggests a transfer from abundant native hosts. These two species of parasites were frequently observed examining peach twigs and on one occasion four specimens of *Glypta* were seen on the same tree at one time. The majority of the spin-ups examined on bark and the outer surfaces of fruit also contained parasite cocoons. The almost complete parasitism of the larvae of this generation appeared quite general and its effect was observed in a sharp reduction in the population of the moth in the orchards.

It should be borne in mind that the percentages offered for the different points, unless otherwise noted, were secured from collections of infested twigs. Percentages of parasitism in larvae feeding in fruits are generally considerably lower, due to the protection offered the host by the thickness of the fruit pulp. The relative percentages of larvae in twigs and fruit during the different generations have not been definitely determined.

Because of the scarcity of larvae, no extensive third generation larval collections were undertaken and no figures are available for this period.

SUMMARY

During the season of 1931, the biological control agencies were probably the chief factor responsible for the sharp reduction in the abundance of the Oriental Fruit Moth in Ontario. From the appearance of the Oriental Fruit Moth eggs on the foliage until the mature larvae pupated, they were subjected to heavy mortality from parasites. Large numbers of eggs were destroyed by Chrysopid larvae and *Trichogramma*, while the feeding larvae fell victims to at least fourteen species of parasites which produced a high mortality. The most important species of larval parasites were *Macrocentrus ancylivora* Rohwer, *Glypta rufiscutellaris* Cress., and *Cremastus minor* Cush. *Macrocentrus ancylivora* Rohwer, the imported species, is firmly established in the region of St. Davids, Queenston and Niagara-on-the-Lake, and was also recovered from all the 1929 and 1930 colonization points.

OBSERVATIONS ON THE OUTBREAK OF SOD WEBWORMS DURING THE SEASON OF 1931

By GEO. M. STIRRETT and D. A. ARNOTT

Dominion Entomological Laboratory, Chatham, Ontario.

During the season 1931, various species of crambids were in outbreak abundance in Ontario and parts of the Eastern and Middle Western United States. In Ontario three distinct types of vegetation were injured, (1) grasses in lawns and golf courses, (2) grasses in pasture lands and meadows, (3) cultivated crops as grains, tobacco and corn. The outbreak in lawns and golf courses and in pastures and meadow lands were the most widespread and injurious on record.

Although crambids are present in more or less numbers every year, there are very few Canadian records regarding these insects as pests. This is largely because crambid injury is not very noticeable unless very severe.

In the present paper, a review of the outbreaks on lawns and golf courses, and on pastures and meadows will be given as these were the most severely injured during 1931.

CRAMBIDS ATTACKING LAWNS AND GOLF COURSES

HISTORICAL.—Very few records of injury to lawns and golf courses by crambids have been reported. Mozzette (18) reports injury to lawns in Florida by *Crambus haytiellus* Zincken during 1921.

De Charmony (8) reports that on the island of Mauritius lawns were injured by an unknown species of crambid during several years previous to 1913. In 1928, the same author (9) reports *Crambus seychellellus* Fletcher as injurious to lawns on the same island. Brock (6) reports *Crambus bonifatellus* Hulst., and *Crambus cypridalis* Hulst., as attacking the roots of blue grass and clovers in lawns in California during 1929. In Connecticut, Friend (13) reports *Crambus leachellus* Zincken as injurious to golf greens during 1929.

In Canada, no reports to lawns and golf courses have been recorded until the outbreak of 1931. However, investigations show that in Southwestern Ontario crambids did at least minor injury to lawns and golf courses during the years immediately previous to 1931.

DISTRIBUTION OF REPORTED INFESTATIONS, 1931.—Injury to lawns and golf courses was distributed over a wide area in the United States during the season of 1931. The insect was in outbreak form in the following states: Virginia, Florida, Pennsylvania, Kentucky, Ohio, Indiana, Illinois, Iowa and Michigan. Most of the injury occurred in late July and throughout August.

In Canada, reports of damage were received from Ontario and Manitoba. In Ontario reports of injury or observations on injury were made in the following counties: Essex, Kent, Lambton, Middlesex, Elgin, Welland, Brant, York, Ontario, Simcoe and Peterborough. The worst infestation and the only ones attracting the attention of the layman were located in Essex, Kent and Middlesex counties. Mr. Norman Criddle of the Entomological Branch, Treesbank, Manitoba, reported lawns as being injured in Winnipeg. The greatest amount of damage in Ontario was done in the section of Essex county between a line drawn from Belle River and Leamington westward to the Detroit river. Nearly every lawn in this district was damaged, as also were the greens and fairways of golf courses. In some cases the grass was killed out completely and reseeding was necessary.

The damage was occasioned by a number of species chief of which were *Crambus trisectus*, Walker, *Crambus teterrellus* Zincken and *Crambus leachellus* Zincken. In Winnipeg, the injurious species was determined by Dr. J. McDunnough as *Crambus dorsipunctellus* Kft.

DESCRIPTION OF OUTBREAK IN ONTARIO AND BIOLOGICAL NOTES.—First reports of injury to lawns and golf courses were received on July 28 and 30. At this time injury was well advanced. During the first part of August, hundreds of reports of injury were received by the local agricultural offices of the district. Crambid injury makes the grasses appear as if they were dying from lack of moisture. At first, small irregular brownish patches of a small diameter appear which gradually enlarge and coalesce to form areas of from one hundred and fifty to two hundred feet in diameter, the size of the areas depending, of course, upon the number of webworms present. This summer in some of the fairways of the golf courses investigated, the dead areas could be measured in acres. In most cases, the killing of the grass was attributed to dry weather and it was not until attention was called to the webworms that people realized the real cause of the trouble.

Injury at first was not very noticeable, but when the larvae neared maturity the development of the injury was rapid.



Fig. 1.—A fairway and green showing crambid injury. The grass in the foreground is dead; Tecumseh, Ontario, August 6th, 1931.

During the last of July when injury was first noticed, the worms numbered from twelve to fifteen per square foot around the injured areas in one golf course examined. Most of the larvae were full-grown and pupae were numerous. By August 6, larvae were scarce and pupae numerous and adults of *Crambus teterrellus* Zincken were very numerous on tree trunks and in the longer grasses. From thirty to fifty adults of this species could be collected on a single tree trunk ten inches in diameter. Most of the adults rested on the trunks between the ground surface and a height of fifteen feet. They always rested on the leeward side of the trees.

Larvae were found in tunnels of about from two to three inches in length. The tunnels were formed in the maze of dead grass blades and the crowns of the plants just above the surface of the ground. Sometimes the tunnel rested in a slight depression formed in the soil. Although larvae of *Crambus trisectus* Walker, *Crambus teterrellus* Zincken, *Crambus leachellus* Zincken and others were present in the grass, our casual observations could not distinguish between the type of tunnel made by the different species.

Pupae of all species were found enclosed in silken webs among the grass crowns, partly in grooves in the soil. Pupal webs generally were found in the horizontal position in relation to the soil surface, although some were slightly tipped upward, the upper end of the webs having a small opening.

In the golf courses studied in Essex county, adults of several species of crambids were present at all times. *Crambus trisectus* Walker adults were present from July 30 to August 20, but not in great numbers. Adults of *Crambus teterrellus* Zincken were in heavy flight on August 6, but none were seen on August 20. At one golf course numerous adults of *Crambus vulgivagellus* Clemens appeared in flight on August 20. Light trap records at Chatham show a very heavy flight of *Crambus trisectus* Walker between June 16, when the trap was started, and July 14. One thousand one hundred and twenty-nine moths of this species were captured on the night of June 27. The moths of this species were very scarce between July 17 and August 1. Another very heavy flight took place between August 12 and September 15. Injury by this second brood of larvae became apparent during the middle of September in the golf courses at Essex and Tecumseh. The worms were not noticed by the greenkeepers until injury was quite extensive. The damage in September cannot be attributed to any particular species, but was probably caused by *Crambus trisectus* Walker and *Crambus teterrellus* Zincken. By October 26, the grass in the infested areas was so badly injured that it was completely killed.

The webworms on October 26 were very abundant in one golf course examined—as many as two hundred per square foot being noted. These worms were found about one-quarter to one-half inches in the soil, lying curled in pocket-like cells. The fairways that had not been infested to any appreciable extent in August were badly attacked by the second brood which injured these fairways just as severely as those injured by the first brood larvae.

Observations indicate that all kinds of grasses were readily eaten. The smaller, softer grasses such as the bents, blue grasses and redtop were injured before the taller and harsher fescue grasses. Plants noted to be uninjured include white dutch clover, alsike, dandelions and plantain. In one lawn in which the grass was completely destroyed, the white dutch clover, dandelion, redroot, pigweed and curled dock were uninjured; but cultivated plants such as gladioli, asters and portulaca were slightly attacked. The larvae climbed the plants to devour the leaves on the gladioli and attacked the asters near the base of the stems. In this lawn, the larvae were found to be very abundant on July 28. The lawn was completely destroyed and the larvae were apparently migrating in search of food as they were swarming over the surface of the lawn, cement sidewalk and even crawling up the side of an adjacent building. The lawn was a new one and had been sown on May 1, 1931. The land on which the lawn was situated had been under a flooded condition for two years previous, having been drained in the spring of 1931. No grass except marsh grasses were within a mile or more of this isolated grass area and hence moths, to lay eggs for the infestation, travelled at least a mile. The eggs, of course, were deposited after May 1.

PARASITES AND PREDATORS.—Parasites were not very noticeable in the field. Larvae, however, collected from infested lawns and golf courses and reared in the insectary showed about thirty-five per cent. parasitism. The parasites belonged to three unidentified species of the order Hymenoptera. No disease was noticed in larvae in the fields. The larvae were readily fed upon by birds and on golf courses, flocks of thousands of individuals could be seen hunting out and devouring the webworms. The birds observed feeding on the larvae included robins, grackles, flickers, starlings, crows, killdeer and a species of sandpiper. The feeding birds made the grass areas much worse in appearance as they dug the insects out of the tunnels. Some lawns were quite ragged in appearance due to the birds; where previously there was smooth dead grass, the birds left a roughened and pitted lawn.

CONTROL

Previous to 1931, there are only three papers dealing with the control of crambids in lawns and golf courses. In 1913, De Charmoy (8) used kerosene emulsion against *Crambus seychellellus* Fletcher in lawns in the Mauritius with good results. Later in 1928 this author states that a solution of calcium cyanide—one part in five hundred gave the best results. In Florida, tobacco dust was used against the larvae of *Crambus haytiellus* Zincken in lawn by Mozzette (18), but the results obtained were not conclusive. The dust was applied by a hand duster. In Connecticut, Friend (13) in 1929, treated golf greens with arsenate of lead and found little or no injury. The species concerned was *Crambus leachellus* Zincken.

Observations made on golf greens early in the outbreak in Ontario would indicate that arsenate of lead has at least some beneficial result in controlling the worm. Greens treated by the greenkeepers with arsenate of lead, at the rate of from two and a half to three pounds per one thousand square feet, in June, were in good condition towards the last of July, while all other surrounding grasses in fairways and which were untreated, were badly damaged. When the crambid outbreak was at its height, the greens were again treated with lead arsenate at the rate of four pounds to one thousand square feet. When the second brood infes-

tation of larvae developed in September, these greens showed very slight injury, while the surrounding fairways which were untreated, were badly damaged. It must be remembered that the greens were all heavily watered and heavily fertilized during the entire season, while the fairways were only watered after the crambid injury had developed. It is very hard to judge between the merits of the lead arsenate and the effect of frequent watering.

Experiments conducted by the laboratory staff during the past season are not conclusive and further work will have to be done before a statement regarding definite control measures can be given.

CRAMBIDS ATTACKING PASTURES AND MEADOWS

Crambids are always more or less troublesome in pastures in Ontario, although reports of injury are not numerous. Morris (17) reports *Crambus* species as injurious to pasture lands at Port Hope, Ontario, during 1915. Corcoran (10) states that the following species were abundant in grasslands in Quebec during 1916:—*Crambus leachellus* Zincken, *Crambus agitatellus* Clemens, *Crambus mutabilis* Clemens, *Crambus tristectus* Walker and *Crambus alboclavellus* Zeller.

In 1931, crambids were more injurious on pastures than during any other year of which we have record. The main outbreak seemed to be centred in Halton Peel and Halidmand counties, Ontario, where some twenty-five acres were badly damaged. Injury was also noted in pastures near Chatham, Ontario. Reports from the United States of damage to pastures are only two in number to date. One each from Ohio, citing *Crambus teterrellus* Zincken and one from Iowa designating no particular species.

Several visits to the infestation near Streetsville in Peel county were made by members of the laboratory staff and also by Professor Caesar, who has very kindly lent his notes for inclusion in this report. Three fields within a mile of each other were severely attacked. These were old pasture fields, one having considerable alfalfa scattered through it. These fields were examined on May 28 at which time the damage was at its height.

Examinations showed that besides crambid larvae, there was a considerable number of cutworms, some wireworms and numerous grasshopper eggs.

In an area of seventy-two square feet, the following numbers of individuals were found: 21 parasitized larvae (crambids); 155 dead diseased larvae (crambids), 2 cutworms, crawling in grass and 432 larvae living in crowns and soil (crambids); a total of eight plus individuals per square foot of sod. The parasitized larvae were clinging to upper ends of grass blades. Parasitized individuals were mainly cutworms as only three out of twenty-one specimens examined were crambid larvae. The parasites have not been identified specifically, but Mr. A. B. Baird states they are a species of *Apanteles*. Of crambid larvae reared in the insectary six out of sixty-two were parasitized by the same species. The diseased larvae were all crambids, as was shown by an examination of the head capsules. The fungus causing death has been identified by Dr. Gussow, Dominion Botanist as a species of *Empusa*. No cutworms were seen killed by this disease—a remarkable example of biological specificity, as the cutworms were frequently the same ground as the crambid larvae. In some cases more than one diseased larva crawled on a grass stem to die as on one hundred and forty-two grass stems, one hundred and fifty-five larvae were found. On a second visit to the fields on June 28, the parasitic cocoons on grass blades so numerous in May had nearly all disappeared. What crambid larvae left seemed to be inactive.

At this time, hundreds of adults were in flight over the field and presumably these emerged from the injured fields. An attempt was made to obtain an idea of

the number of adults over the field. In the longer grass areas, eighty-seven moths per one hundred paces were counted, while in the dead bare areas, only twelve per hundred paces could be found. The species in flight during this visit were *Crambus hortuellus* Hubner, *Crambus lacqueatellus* Clemens and *Crambus trisectus* Walker. Seventy-five per cent. of the moths in flight were of the first species, seventeen per cent. *Crambus lacqueatellus* Clemens, and eight per cent. *Crambus trisectus* Walker. As shown by later emergence, *Crambus vulgivagellus* Clemens was also very common in the field. In fact, this was probably the most common species as all larvae brought to Chatham matured to this species. The larvae of this species aestivate during the summer and do not emerge until August and September. This is plainly seen from light trap records obtained at Chatham which shows the flight of this species to have taken place during 1931 from August 17 to September 22. The heaviest flight being from September 1 to September 16.

No control measure were attempted in regard to crambids attacking pastures and meadows.

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OBSERVATIONS ON THE OUTBREAK OF GREEN CLOVER WORM ATTACKING BEANS DURING THE SEASON 1931

GEO. M. STIRRETT

Dominion Entomological Laboratory, Chatham, Ontario

The green clover worm, *Plathypena scabra* Fab., was very abundant and destructive in Southwestern Ontario during the season 1931. Because of its importance as a pest and because this is the first recorded widespread outbreak of the insect that has occurred in Canada, it is thought advisable to bring the known economic history of the insect up to date; to describe briefly its recorded biology and to note the observations made during the past season in Ontario relating to the damage caused by the insect; its life history, food plants and control.

HISTORICAL REVIEW

PREVIOUS ECONOMIC HISTORY IN NORTH AMERICA.—The green clover worm has been known as one of our common insects for many years. Only periodically, however has it become abundant enough to attract attention because of its injury to plant life. Comstock (5) in 1879 noticed it as being very abundant on clover in the vicinity of Washington, D. C., while Coquillett (6) found it abundant in Illinois during 1881. Chittenden (4) observed it to be abundant enough to be injurious to beans and clovers in the vicinity of Washington, D. C., during the season of 1897 and 1899. Nothing further was observed regarding the insect as a pest for a period of some nine years when Britton (2) records it as being abundant on beans in Connecticut during the season of 1908. Another period of six years elapsed before Hill (12) found it abundant enough on alfalfa fields in Tennessee during 1914 and 1915 to undertake life history and control studies on the insect. During 1919, the first recorded widespread and injurious outbreak of the insect occurred. That year, it was very abundant throughout the greater portion of the Eastern United States and especially in Virginia, North Carolina, Connecticut, New York and Massachusetts. The crop most severely injured was soy beans, but kidney beans, cowpeas, alfalfa and clover were also damaged. During this outbreak only one report of injury in Canada was recorded. Mr. J. T. Brimley of Wellington, Prince Edward County, Ontario, wrote to the Department of Agriculture at Ottawa on October 20, 1919, stating that the insect was injurious to canning beans in his district. The green clover worm has not been reported in literature as a pest in North America since the intense outbreak of 1919, until the present year, a period of twelve years.

LIFE-HISTORY AND OTHER BIOLOGICAL NOTES.—The life-history of the insect has been studied by Comstock (5), Coquillett (6), Chittenden (4), Hawley (9), Balduf (1), Hill (12), Smith (23), and Sherman (21), while others have contributed various observations made during periods of abundance of the insect. The moths, which are sexually dimorphic, hibernate during the winter in farm and other buildings, under bark of trees, and under any other type of covering affording sufficient protection. The winter may also be passed in the pupal stage, according to some authors. In the vicinity of Washington, D. C., Chittenden (4) observed three generations, while at Knoxville, Tennessee, in 1916, Hill (12)

found four distinct generations. Balduf (1) states that there are probably three generations at Marietta, Ohio, while Hawley (9) states that there are two in New York State, but that sometimes a partial third generation might occur.

Most of the recorded injury has occurred during July and August. Hawley (9) states that in New York State the injury to beans is done by what is apparently the second generation; the first generation developing on other plants. The total length of time for the development of a generation in summer is given by Sherman (21) as fifty-one days. Hill (12) states that on the average, thirty-nine days are required from the deposition of eggs until the adult moths emerge. The larvae ordinarily feed on leguminous plants as alfalfa, red clover, soybean, kidney beans and cowpea, but the following also have been observed as food plants: blackberry, strawberry, velvet bean, vetch, and a few other plants. Hill (12) gives a complete list of the known food plants.

There is a long list of predators and parasites which have been found to attack this insect, a summary of which is given by Hill (12). A fungus disease attacking the worms has also been recorded by the same author. This fungus was formerly identified as *Botrytis rileyi* Farl, but it is now (27) thought to be a species of the genus *Spicaria*.

THE CAUSE OF THE 1919 OUTBREAK.—Britton (3) infers that the type of winter had a great deal to do with the increase of the insect as he states that the winter of 1918-19 in Connecticut was very mild and in striking contrast to that of 1917-18. Hawley (9) for New York records that the insect was very abundant in 1919 after a mild winter, but states that in the same region during 1917 and again in 1918, only four larvae could be found. In 1920 after the severe winter of 1919-20, only one larva was found by him.

THE OUTBREAK OF 1931

The outbreak of the past season was very extensive. Mr. J. A. Hyslop of the United States Bureau of Entomology, Washington, D. C. (letter) has furnished reports for the United States. The following states have already reported damage: Iowa, Nebraska, North Carolina, Virginia and Tennessee. At Des Plaines, Illinois, on June 13, moths were reported at light traps in very unusual numbers. Among the crops injured were soybeans, clover alfalfa, garden beans and cowpeas.

In Canada, the insect was abundant in the following counties in Ontario: Huron, Kent, Lambton, Essex, Middlesex and Elgin, while Professor L. Caesar of the Ontario Agricultural College, Guelph, Ontario (letter) received one inquiry from Port Hope in Durham county. Although abundant and noticeable in all of the counties mentioned above, extensive damage was caused only in Kent county, though less severe injury was occasioned in the western section of Elgin county. In the other counties, the larvae, although noticeable, were not abundant enough to permanently injure plants.

The plants attacked in Ontario were white and yellow eyed kidney beans, soy beans, clover and alfalfa. The only economic damage was done to kidney beans.

BEAN PRODUCTION IN CANADA AND IMPORTANCE OF INDUSTRY IN AREA INFESTED.—The average production of kidney in Canada for the years 1925-30 according to the Dominion Bureau of Statistics was 1,312,870 bushels; sixty per cent. of this average yield being produced in the counties of Kent, Elgin and Huron. The five counties of Kent, Huron, Elgin, Lambton and Middlesex grow over eighty-seven per cent. of the bean acreage of Ontario. Kent County is the largest single producer with a kidney bean acreage for 1931 of twenty-six thou-

sand acres. Well over sixty per cent. of the beans in Kent county are grown in the southern third of the county south of a line drawn from Charing Cross on the Raleigh-Harwich township line to the vicinity of Highgate in the extreme eastern section of the county. In addition, Kent and Essex counties grew, during the present season, some twenty-five hundred acres of soy beans for seed purposes.

AMOUNT OF DAMAGE.—As stated above, Kent county and a small section of Elgin county were the only areas in which appreciable damage occurred. In Kent county the yield of beans was materially lessened; the average yield for this year being estimated at twelve bushels per acre. The normal average yield is sixteen bushels per acre. The kidney bean yield therefore, in Kent county, was reduced twenty-five per cent. by the ravages of the green clover worm. This means a loss to the growers, even at the present very low price of beans, of some seventy-two thousand eight hundred dollars. Beans were quoted on the Chatham market at seventy cents per bushel on November 14, 1931.

The twenty-five per cent. reduction in yield, however, is not the only loss occasioned by the worm. Many of the harvested beans are small, deformed and show feeding scars of worms. Elevator dealers of the district asserted that the wastage in picking during the grading of the beans this year ran from five to ten per cent. Normally, wastage in picking is less than two per cent.

AREA OF SEVERE INFESTATION.—The area of heaviest infestation was the great bean producing area of Kent county, but even within this section the infestation and damage was not evenly distributed. The area of greatest damage was that embraced by the towns of Highgate, Muirkirk, Duart, Palmyra, Morpeth and Ridgetown. In this area a few fields were so badly destroyed that they were not harvested. In fields harvested, the yields varied from two to twelve bushels per acre. A second area of severe infestation and damage was in the district embraced by Charing Cross, Cedar Springs and Blenheim. In this area yields ranged from four to ten bushels per acre. In other districts, the bean foliage was mostly devoured, but fair yields were obtained; the highest yield reported to date being eighteen bushels per acre. The areas outlined grow about sixty per cent. of the total acreage of the county.

During the outbreak the price of beans advanced from seventy cents per bushel on August 11 to a dollar and a quarter on August 20, and then gradually returned to the present value (November 14) of seventy cents per bushel. The bean growing section of Ontario was threatened and it looked for a time at least, as if the whole crop would be ruined.

DESCRIPTION OF OUTBREAK AND BIOLOGICAL NOTES.—The outbreak and damage came on very suddenly, at least everyone seemed to notice the presence of the larvae on beans at about the same dates. The first larvae was found by a member of the laboratory staff on August 5 and brought to the laboratory for identification. On August 8th, the first report of injury was brought to the laboratory by a grower from Cedar Springs and by August 11, hundreds of calls and inquiries were received by the Agricultural offices of the district. The grower reporting on August 8 stated that he had seen the worms on his beans about a week previously. The injury or eating of the leaves developed very rapidly. The larvae disappeared as rapidly as they had come. By August 20, about seventy-three per cent. of the larvae had pupated and moths were emerging in the destroyed bean fields by the hundreds. Nearly all larvae had disappeared by the first of September.

On August 20, a count in a seventeen acre bean field was made to determine the numbers of insects present. The foliage was completely destroyed at this date. In six lineal feet of bean row two hundred and fifty-one individual stages

of the insect were found as follows: living larvae, 22; pupae, 148; pupal shells (emerged), 34; larvae dead of disease, 47. This field yielded 11.5 bushels per acre when threshed in November. The farmer stated that it yielded much more than he expected. The yield should have been twenty-five bushels per acre as it was a promising field before being injured by the clover worm. The larvae pupated within the first inch of soil under the bean plants. Many, however, were also found in dead leaves on the ground or between dead leaves and the ground surface.

All the pupae so far as could be determined emerged. An examination on November 14 for pupae in an unharvested bean field yielded only four empty pupal cases, both pupae and empty cases having disappeared. One would expect to have found the empty cases much more frequently, judging by the severe injury.

Early bean fields were the most heavily damaged. These fields, in the majority of cases, were planted during the first week in June. Late beans were just commencing to bloom by August 11 and the larvae were not nearly as numerous on these. The pods on the early beans were just commencing to fill when the infestation was at its height.

The larvae devoured the leaves, feeding mostly on the under surface, and having a tendency to eat on the upper third of the plants. After the leaves were eaten, or in some cases even when there still remained plenty of leaf foliage, the pods were eaten into. In several fields examined, about five per cent. of the pods were injured. After being defoliated the plants matured quite rapidly and consequently, injured plants bore many very short, shrivelled pods, some of which passed through the threshing machines and were taken out in the cleaning process at the elevators. The injury would probably have been much more severe except for the very heavy foliage possessed by the bean plants this year.

Soybeans were not injured to any extent, although some fields were given a whitish appearance by the larvae eating the leaves.

Light trap records at Chatham show that no moths were caught in the trap between June 15 and 30. Flight commenced July 5 and continued until October 3. Bait trap records, however, show a flight until October 26. The heaviest flight (light trap) took place between July 13 and August 3. At Harrow, in Essex county, a county which reported no injury, moths were in flight from July 8, when the light trap was started, until September 6. None were taken after this date, although the trap was operated until October 10. The catch at Harrow was very small in contrast to the one taken in the light trap at Chatham. The bait trap catch in a field was much heavier than the catch in a bait trap using the same bait but situated in a small woods. The bait trap catch in the field was heavier than the light trap catch, although the two traps were only about three hundred yards apart. On the night of October 6, 103 moths were captured in one bait trap.

No parasites were observed except that it was noted that about August 20, many larvae were dying of a disease. The larvae became sickly and after death turned a blackish colour. A count showed that in one field, 18.7 per cent. of the worms had died of the disease by August 20. The fungus responsible was determined as *Entomophthora* sp. or *Empusa* sp. by Dr. Gussow, Dominion Botanist. The epidemic of disease among the larvae was fairly general over the district.

Moths which emerged from pupae collected on August 20 and later in the fall, refused to deposit eggs and died in their cages.

Previously, only a very few examples of this insect had been noticed in Kent county. In 1929, moths were noticeable and attracted attention largely because the form was not recognized. Specimens were sent to Ottawa for determination. During 1930, only a few larvae were noticed on beans. No reports of injury were obtained. Mr. J. T. Brimley states that in Prince Edward county there are always a few worms on beans.

CAUSES OF OUTBREAK.—Very little is known regarding the causes of the outbreak in Ontario. As has been suggested by Britton (2) and Hawley (9) a mild winter apparently caused the outbreak of 1919 in Eastern United States by allowing more adults than usual to survive the winter. If this actually was the main cause of the outbreak, then we would expect our very open and mild winter of 1930-31 to have acted in a similar manner.

The winter of 1929-30 was also a mild one except for the very cold month of December.

Two mild winters in succession may have allowed the species to increase to outbreak proportions by the season of 1931. Very little is known of the pest during the season of 1930, except that a few larvae were noticed on beans. No injury was reported during that year. Nothing is known regarding the history of the insect in the spring and early summer of 1931. No injury was reported and yet the first generation of larvae must have been abundant in the district heavily damaged by the second generation in August and September. It is very probable that the first generation developed on alfalfa and clovers, although no injury was reported in these crops until August when the second generation of larvae were prevalent. Climatic factors, however, must have been very favourable during the development of the first generation.

CONTROL

CONTROL FOR BEANS.—Britton (3) states that arsenate of lead solution used at the rate of two pounds to forty gallons of water gave good control on garden beans. Nicotine sulphate was also recommended at the rate of one teaspoonful to one gallon of water, with the addition of one ounce laundry soap. For a very few bean plants a strong spray from the garden hose was also recommended as satisfactory. Hawley (9) recommends arsenate of lead at the rate of one to one and a half pound of the powder to forty gallons of water. Smith (23) also recommends the same mixture. This author also recommends a dust composed of five pounds of arsenate of lead to fifty pounds of land plaster. These two are for use on snap beans. For soy beans the recommendation was arsenate of lead—one and one quarter pound, and hydrated lime, two pounds to forty gallons of water. Sherman (21) during the outbreak of 1919 in North Carolina recommended arsenate of lead at the rate of two pounds to forty gallons of water or a dry mixture of arsenate of lead, one pound to eight pounds hydrated lime for soybeans. He states the results were very pleasing and stresses the necessity of promptness and early applications. Sprayed soybeans were used for hay at harvest time without any ill effects to livestock. None of the authors report injury from arsenate of lead burning the bean foliage.

Since the Mexican bean beetle has become a pest of cultivated beans, a considerable amount of research has taken place regarding the tolerance of bean foliage to arsenicals and it has been found through experimental work and practise that arsenate of lead is very liable to burn bean foliage in many districts. Huckett (15), Thomas (25), Howard (14) and others have studied this problem and none recommend arsenate of lead for bean foliage.

When the outbreak of green clover worm on beans developed in Ontario, we were at a loss to know what to recommend for those wishing to spray, no bean

spraying having never been done in our district. It was finally decided to use the standard Mexican bean beetle applications as worked out in the United States.

For dry dusting treatments (1) calcium arsenate, 1 pound and hydrated lime, 5 pounds; and (2) magnesium arsenate, 1 pound and hydrated lime, 5 pounds were used. Whichever dust is used, the two ingredients must be mixed thoroughly and applied at the rate of from fifteen to twenty pounds per acre. For liquid spray treatments (1) calcium arsenate, 1 pound with hydrated lime, 3 pounds and water, 40 gallons; and (2) magnesium arsenate, 2 pounds and water, 100 gallons were used. The liquid sprays were applied at the rate of from eighty to one hundred gallons per acre.

Less than five per cent. of the growers sprayed their plants, but where applications were given beneficial results were obtained in most cases. No reports of burning of foliage were received.

The main difficulties in control lie in the facts that (1) very few growers have spray or dusting machines of any type or if they possess machines they are not adapted to bean crop spraying; (2) the outbreak was not noticed until most of the injury was done; (3) insecticide dealers did not have enough arsenicals on hand to supply growers for prompt applications; and (4) plants to some extent are broken down by horses and wheels of spray outfits. The damage done by spraying sometimes is greater than the benefit, although fields of soybeans were sprayed with remarkably little injury from teams or outfits.

The outbreak in Ontario clearly pointed out the need for investigations along the lines of insecticidal tolerance of the various types of beans grown in our district and it is hoped that some of this work can be accomplished during the coming season. The bean crop of Ontario is too valuable to lose because of the lack of knowledge of safe spray materials.

Smith (23) states that the pupae can easily be killed by covering with two or more inches of soil. This could be done by ploughing two shallow furrows up against the bean rows. In Ontario this would seem impracticable as the worms pupate during approximately a month's time. Beans are harvested in late August or in September and the fields are then generally ploughed or disced in readiness for the next crop. If the field was absolutely ruined and not worth harvesting, it would be best for the sake of control to plough it immediately to prevent the worms and pupae from maturing.

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NOTES ON THE ONION MAGGOT, (*Hylemyia antiqua*, Meigen)

E. W. KENDALL, JN,

Ontario Agricultural College, Guelph

PREOVIPOSITION PERIOD

This is a problem that has hardly been solved satisfactorily in my work because of the difficulty in getting flies to lay eggs in cages. Most writers have given the period as 7-11 days or longer. While this corresponds with the general results that I obtained, I have had some interesting exceptions. In 1930 one fly had a preoviposition period of only 4 days, and in 1931 of a number of ovaries of flies examined three days after emergence two had eggs in them that were practically mature. This would indicate that a shorter period than seven days does sometimes occur. The length of the oviposition period is of course important in determining the time to begin control measures each spring. In spite of the above exceptions field observations indicate strongly that one is safe in estimating the preoviposition period at about a week.

THE EMERGENCE OF THE FLIES IN RELATION TO NATURAL PHENOMENA

Flies begin emerging sometime in the month of May. In 1929 this was on May 31st, in 1930 on May 9th, and in 1931 on May 20th. Flies may be expected in the field about the time peach blossoms have fallen, apple trees are beginning to show pink and blossom clusters are appearing on the Concord and Niagara grapes. At this date the dandelions are just passing the height of their bloom and spiraea are just coming into bloom.

The most convenient of these phenomena to act as guide is when apples are in the pink. This will mean that spraying for the fly should commence about the time apple blossoms have fallen and the calyx spray is being applied. If onions have been planted late and are not above ground at this time, treatment of them should begin as soon as they are sufficiently high to be able to see the rows clearly.

THE MOVEMENT OF LARVAE UNDERGROUND

There is a distinct tendency for larvae to migrate from a dying onion to a living onion. This is often seen in a field where close observation will show that onions are being killed in regular little swaths. As the length of the swath increases, the size of the maggots in the onion just being attacked increases, thereby indicating that this is a migratory movement. This movement is noticed chiefly when onions are small and are killed easily. From experiments in bringing maggots of different ages at a depth of three inches and at different distances away from onions it was seen that most maggots, more than seven days old but under twelve, were able to reach onions ten inches away, inside of twenty-four hours. If the maggots were younger than seven days they usually perished in the attempt, and if they were older than 12 days, they pupated before reaching the onion.

THE CAUSES OF THE SMALL AMOUNT OF INJURY BY THE SECOND BROOD LARVAE

In 1930 the 1st. brood of adults at the peak of egg laying deposited 176 eggs on 100 plants examined. Flies of the second generation at the peak of egg laying laid 1688 eggs on the same plants, and yet injury from larvae of the second generation was almost nil.

The cause seemed to be *first*, that the flies of the second generation laid almost all their eggs on onions, which had been infested by the first brood. For instance, out of 1116 onions 717 had eggs of the second brood and of these 693 or 96.6% had been infested by the first brood. Leaving only 3.4% uninfested plants that were laid upon.

Second, there is a lessening in the damage from the second generation due to the increased size of the onions themselves. This is shown up particularly well in seed onions. A single larvae of the first generation will, while the onions are still small, often kill from four to five plants. But by the middle of July, the onions are so large that they will be found with from fifteen to twenty maggots in them and still be living. Therefore, the damage done by a single maggot of the first generation as compared to that of the second generation has been reduced by about sixty times. Let me make this clearer. If one maggot of the first generation kills four onions and one onion will support fifteen maggots of the second generation, it means the maggot of the first generation does sixty times as much damage.

Third, from data collected it would appear that because of hot weather and desiccation, fewer eggs hatch in July than in June.

A fourth possible reason is that parasites are just becoming reasonably effective in July, having taken the first part of the season to establish themselves.

CORROSIVE SUBLIMATE AS A TREATMENT FOR ONION MAGGOT

Where growers have used Corrosive Sublimate alongside of oil as a treatment for the onion maggot in the district, they have favored corrosive sublimate. The reasons for this are as follows:

First, considerable trouble has been experienced from the burning and stunting of plots by the oil. In some cases this loss has been greater than the loss sustained from the maggot themselves. The first application of oil evidently does the greatest amount of damage, especially so if the weather had been hot. The onion tops take on a dirty green color, some are killed and many of the tops are stunted or burned in the worst cases. By the time of the third application the onions seem to be able to withstand the effects of the oil quite easily and can even stand a spray stronger than 2%.

Second. In dry seasons those treated with corrosive sublimate show a decided increase in growth, even over the check rows. This stimulation in growth is probably due to the added amount of water used in the treatment.

Third. The application of the corrosive sublimate requires no new implements other than those which the farmer has already at hand. Whereas oil will require a special spray machine, (the ordinary type not being very satisfactory) and growers are more ready to use what they have on hand than to purchase new equipment.

The results which I have obtained for the last three years would show that corrosive sublimate gives as good control and a slightly better yield. Corrosive sublimate is especially of value to the person who has only a small plot of onions, where the mixing and application of oil would be much more trouble than the simple application of corrosive sublimate.

Corrosive sublimate will cost from six to seven dollars more per acre for treatment when labour costs are taken into consideration. In normal years a good field of onions is worth from five hundred to seven hundred dollars an acre, and the farmer would rather pay the extra for the corrosive sublimate than risk burning his crop.

NOTES ON *Taeniothrips gladioli* Moulton and Steinweden

By ALAN G. DUSTAN and W. G. MATTHEWMAN

Entomological Branch, Ottawa

The history of the gladiolus thrips (*Taeniothrips gladioli* Moulton and Steinweden) seems to be rather obscure, for although there are no earlier records of the insects there is little doubt that it must have been present in Canada and the United States many years prior to its discovery in 1930. In that year, specimens collected at Vineland, Ontario, were forwarded by the Systematic Division of the Entomological Branch, Ottawa, to Dudley Moulton who reported that this was a new species and gave it the name stated above. This was the year of the first big outbreak and since that time it has been reported from many points in Canada and the United States. In Canada, the insect is very abundant in the provinces of Ontario and Quebec and has been reported from Nova Scotia, New Brunswick and Manitoba. It is the most serious enemy of gladioli to-day and it is felt that unless an effective control is discovered in the very near future that the industry will be very seriously threatened.

In the Ottawa district, the extreme importance of the insect was recognized in the summer of 1930, although reports of injury by an unknown thrips in isolated gardens had been received the previous year. In the fall of 1930 it was decided to carry on a winter study of the thrips with a view to finding out whether it was able to winter over on the corms, if it bred in storage and, if possible, to work out a suitable control. Arrangements were made with a local grower, whose plants had been badly infested that year, to allow us to carry on the study in his cellar where the corms were stored. As a result of this investigation it was found that thrips went into storage on the corms and when temperature conditions were right, that is when the corms were stored at a temperature of around 70° F., the insects were able to develop in enormous numbers. At this temperature extensive feeding took place which weakened and disfigured the corms. Infested corms which had been extensively attacked took on a rusty-red appearance as a result of being covered with what looked like a fine red powder. This was thought to be made up of tiny droplets of juice which had exuded from the feeding scars and become dry when exposed to the air. The corms became literally covered with these little scales of dried plant juice which could be readily rubbed off by the hand.

When it was found that the thrips were wintering successfully on the corms, fumigation tests were run to find some method of killing them before they were planted in the spring. It was found that excellent results were secured from a mixture of ethylene dichloride (75%) and carbon tetrachloride (25%). Complete killing of thrips and mites took place and subsequent growth tests in the greenhouses of the Central Experimental Farm showed that the corms were quite uninjured by the treatment. The fumigant was used at the rate of 14 pounds per 1000 cubic feet and a 24 hour exposure at a temperature of 70° F. given. To hasten evaporation, rolls of blotting paper were placed on top of the corms in the fumigation chamber and the fumigant poured on these. Treated corms were planted out last spring on the same piece of ground which had been so heavily infested in 1930 and although other gladioli in the district were severely injured

the blooms from this plot were almost perfect. Although this cannot be looked upon as definite proof it does strengthen our belief that the treatment of the corms before planting checks the infestation to a considerable extent.

During the past summer a sketchy life-history study of the insect was carried on, more to collect data on the progress of the thrips on the plant from earliest spring until they went into hibernation, than to check up on such points as larval stages, number of generations and such like. The work was carried on at the expense of other, already planned investigations, so that the time at our disposal was somewhat limited. It was found that the adults first appeared inside the leaf sheath when the plants were about six inches high. They lived within the leaves during the early part of the summer, feeding and rapidly increasing in numbers. When the spike formed they were already present in it, where they remained until the buds and blooms appeared. As soon as the flowers were formed the majority of the thrips deserted the other portions of the plant and congregated beneath the sepals and in and around the petals. In the case of heavily infested plants, the blooms were practically destroyed before they got a chance to fully open, while in those plants which supported a smaller population the blossoms, although they opened out, had a shrunken and blasted appearance. Whole fields of bloom were seen which looked as though the tops had been scorched by fire. Injury to the foliage took the form of a streaking and whitening of the external tissues and was very similar to the feeding scars made by other species of thrips. When the insects were abundant the leaves took on a silvery appearance, especially towards the tip.

Feeding continued in the blooms until they disappeared, when the thrips again invaded the leaves and stems. As the summer drew to a close and cold weather set in the insects commenced to migrate down the stems and on to the corms. At this time they were also found in numbers in the soil immediately surrounding the corms and it was thought that they were preparing to hibernate there. From the first of October on, however, the population seemed to dwindle away and by the end of the month it was very difficult to find a single thrips on either tops or corms. Through September and October tanglefooted screens were placed in and at varying distances away from the study field and a considerable number of thrips were captured, proving that a movement and migration of the insects from the field was taking place. Daily records were taken on the screens and it was learned that this year, at least, there were no big periods of migration but a gradual, even movement of the thrips from the field outward.

At time of writing (Nov. 1931) it is not known where the thrips have gone. The tops and corms are practically clean and no sign of the insects can be found at any depth in the soil of the gladiolus plot. A large amount of time has been devoted to searching possible hibernating media without results and although careful watch has been kept all autumn the tiny insects have just slipped away. The few that are found on the corms will probably remain there and go into storage and there is a chance that some may winter over in the tops which are left in the field. But where the bulk of the population has gone remains a mystery as yet. It is hoped that further work this fall or next spring will throw some light on the subject.

A study of other possible host plants was carried out in midsummer and again in the autumn in the flower garden at the Central Experimental Farm to find out if gladiolus thrips were present on other blooms. A large number of different flowering plants were examined but in only one case was this species present. Two specimens of *Taeniothrips gladioli* were found on an iris plant but whether they were merely resting there or feeding was not determined. It has since been learned however that in the United States gladiolus thrips have frequently been found on this plant. In the Ottawa district several specimens

of this insect were collected on carnation plants in a greenhouse which was standing next to a bed of gladioli but little importance can be attached to the capture as the thrips were probably there more by chance than by preference.

Control experiments were carried on in the field during the month of August when the infestation was at its peak. Ten different sprays and dusts were applied at weekly intervals throughout the month and results taken by an abundance count on representative blooms before and after each application. An abundance count was also made before any controls had been applied and again at the end of the month after the work had been completed. In general the results were most disappointing. As far as could be learned the majority of the sprays and dusts had no effect whatsoever. Even when the blooms were dipped in the spray or heavily dusted and then placed in sealers the control was slight. The best material judging by our experiments was a spray composed of 2 tablespoonfuls of Paris green, 2 pounds of brown sugar and 3 gallons of water. This had been recommended against greenhouse thrips by Gibson and Ross in Dominion Department of Agriculture Bulletin No. 7, New Series. The great difficulty in control work on the plants is that the thrips are practically all in sheltered and protected situations where the sprays cannot reach them and furthermore, due to the waxy nature of the epidermis, the sprays quickly run off the plants.

Experimental work was also carried on, using calcium cyanide in a small tent in the open. This was tried as it was thought that it might be practical for the small gardener or for a commercial grower who had a few prized plants to protect. Excellent control was secured in this way, using the fumigant, at the rate of six ounces per thousand cubic feet and exposing the plants to the action of the gas for one hour. Fumigation was always carried out on a sunny day when the temperature was 80° F. or higher in the tent. Slight spotting of the blooms resulted with certain varieties, but in actual practice the plants would be treated long before they reached the blossoming stage. An oilcloth tent was used in this work but tents made of heavy brown paper have given perfect satisfaction at other times with a variety of insects.

This autumn some work has been carried on with dips in the hope that a bath might be found which would penetrate the husk sufficiently to kill the thrips and yet not injure the corms. The husk was left on purposely since peeling of the corms before placing them in storage is not recommended and one object in doing this work was to find a practical dip for use at this season of the year. Nicotine sulphate (40%) at different strengths was used and the corms soaked for varying lengths of time but in all cases it was found that the liquid did not penetrate sufficiently well to be effective. The same held true in our experiments with corrosive sublimate. The addition of agral and caprylic alcohol to these insecticides did not appear to increase the penetrating power of these dips. Good control, however, was secured where fish-oil soap was used in a dip at the rate of one pound to four gallons of water. All thrips were killed after soaking the corms in this solution for three hours. The liquid penetrated excellently and worked its way underneath the lowermost scales. Nothing is known as yet concerning its effect on the corms, but they appear to be uninjured and there seems to be no reason why any damage should result from the use of this dip. However, this point is being watched. It is felt that an effective dip can be found for spring use with comparatively little difficulty, as at that season of the year peeling of the corms can be practised with safety. The object of an autumn dip, however, is that if the thrips are all killed no injury to the bulbs or increase of the insects will take place in storage.

The chief aim of this paper has been to give a resume of the work which has been carried on to date and to outline our results. It is felt that when dealing with such an injurious insect as the gladiolus thrips and one that appears to be so difficult to control that all knowledge should be available for the use of other

workers. The control recommendations which we are making to the growers at the present time may be summarized as follows:—

- (1) Clean up all refuse in the gladiolus bed and burn.
- (2) Practice deep fall ploughing or digging late in the season.
- (3) Store corms this winter at as low a temperature as can be done with safety.
- (4) In the spring fumigate with ethylene dichloride (75%) and carbon tetrachloride (25%).
- (5) Spray plants at weekly intervals with 2 teaspoonsfuls of Paris green, 2 pounds of brown sugar and 3 gallons of water; beginning as soon as the thrips appear in the early summer.

NOTES ON CONTROL SUBSTANCES FOR SOWBUGS

By R. W. THOMPSON

Ontario Agricultural College, Guelph, Ontario

An extraordinarily heavy infestation of sowbugs, probably *Porcellio laevis* (Latreille), occurred in a temporary garbage dump, on the outskirts of the city of Brantford, this summer. There were literally millions of these crustaceans present, and the slope where the garbage had been allowed to accumulate was covered with them. These creatures were not causing any particular harm, beyond the fact that they annoyed the householders in the vicinity. They migrated nightly mainly to the cellars and there made themselves objectionable by crawling over preserved fruit and other eatables. The sidewalks during late evening were reported to be black with sowbugs and the occupants of the infested houses threatened to bring suit against the township. I could find no other reason for this outbreak than that much vegetable matter had been dumped on the slope.

Previous to the time of my examinations, parts of the dump had been burned over with coal oil, and loads of sand had been spread over other sections of it. Neither of these measures had any effect on the sowbugs.

Several hundred sowbugs were brought back to the laboratory in order to try out control substances.

The following is a list of the things tried and their apparent efficiency:—

1. *Paradichlorobenzene*, Sprinkled on surface of soil—good.
2. *Naphthalene Flakes*, Sprinkled on surface of soil, *fair* but much slower.
3. *Derris*, As powder and as a spray—1 lb. to 20 gals. of water—*not effective*.
4. *Dry Sulphur*—As barrier—*not effective*.
5. *Lubricating Oil*—effective in laboratory but not practicable on the dump.
6. *Smooth Boards without and with Tanglefoot*—not practicable on the dump because of dust.
7. *Linoleum Strips without and with Tanglefoot*—not practicable on the dump because of dust.
8. *Chloride of Lime*—as barrier—*not effective* because it neither stopped nor killed the sowbugs.

POISON BAITS.—

1. *Paris Green*—1 part, *Brown Sugar*—40 parts (by volume)—*good*.
2. *Paris Green*—1 part, *Icing Sugar*—20 parts (by volume)—*good*.
3. *Sodium Fluoride*—1 part, *Icing Sugar*—20 parts (by volume)—*slower but effective*.
4. *Bran*—*Paris Green*—*Syrup*—*good*.
5. *Bran*—*Sodium Arsenate*—*Syrup*—*good*.

SPRAY MIXTURES.—(Used as contact sprays).—

1. *Flit*. Killed but limited in use.
2. *Flytox*. Killed but limited in use.
3. *Red Arrow* 1-300. No value if sowbugs in soil, but if applied in direct contact with them will kill.
4. *Sodium Arsenate* 1 oz. to 2 gals. of water. Not effective.
5. *Sodium Fluoride* 1 oz to 1 gal. of water. Killed as direct contact.
6. *Sodium Fluosilicate* 1 oz. to 1 gal. of water. Killed as direct contact.
7. *Bluestone*. 1 oz. to $\frac{1}{2}$ gal. of water. Not effective.
9. *Bichloride of Mercury* 1-1000—Effective but too costly.
10. *Yokum Faust Spray Oil* 1-20. Effective only as direct contact.

FIELD EXPERIMENTS

At the garbage dump three plots 20 feet by 20 feet were marked off with check plots of similar dimensions adjoining each. On these plots the most promising of the apparently practicable control substances mentioned above were tried.

1.—PARADICHLOROBENZINE. $1\frac{1}{4}$ pounds per 100 square feet.

Five pounds of this material were used for the plot. Six trenches $1\frac{1}{2}$ inches deep were made at intervals of 18 inches across the surface of the plot, parallel to the top of the slope. The P.D.B. was sprinkled in these and lightly covered with sand. This method was adopted to prevent undue concentration of gas at the bottom of the slope. The application was made at 10.00 a.m. on a calm day with a temperature of over 70° F. At 5.00 p.m. the same day a number of the sowbugs were observed to be paralysed and almost incapable of any movement. By the end of one week the population had decreased considerably compared with the checks on either side. Calculation of the amount necessary for the dump showed that the cost for control would be over one hundred dollars. Hence paradichlorobenzine seemed impracticable.

2.—PARIS GREEN—Brown Sugar Bait. 1-40.

This bait was sprinkled over the surface of the second plot. Very little feeding was noted on the day the bait was set out, but there was considerable decrease in infestation when the plot was examined one week later. It is difficult to say whether this was entirely due to the death of the sowbugs or whether there was also some repellent effect from the bait. The checks on both sides of this plot showed a slight reduction in population.

3.—PARIS GREEN—BRAN—SYRUP BAIT.

This bait which was made up according to a Metcalf and Flint* formula, was distributed over the plot in shallow trenches and was also scattered over the surface of the plot. The bait was buried because the majority of the population was beneath the surface, and also the bait would keep moist and attractive in the soil. Examinations made one week later showed that the population had been reduced but not to such an extent as in the paradichlorobenzine and Paris-Green-Brown Sugar plots.

Any of these three controls could be used where there was some crop to defray the expense of materials. In the case of the garbage dump there was nothing of this nature. Hence, when we found that "slag" from the local malleable works would be delivered at the dump for 50 cents per load we recommended this as the most effective of any control measures. The dump was completely covered with slag to a depth of six inches after the refuse had been levelled. When the slag had settled it was pounded down and left to harden. Rain causes it to form a hard crust, which sowbugs could not penetrate and this practically solved the problem. The slag in addition to controlling the sowbugs, increased the permanence of the newly constructed road-bed and removed an unsightly, unhygienic collection of rubbish.

Some of the other substances tried in the laboratory and in the field could be used to good advantages against smaller outbreaks of sowbugs. Among these the most promising are Paris Green 1 part, Icing Sugar 20 parts by volume; Red Arrow, Mercuric chloride, Flit and Flytox. The latter should not be used in greenhouses, because the rate at which they give satisfactory results is injurious to growing plants.

THE EUROPEAN CORN BORER SITUATION IN ONTARIO IN 1931

By L. CAESAR

Agricultural College, Guelph

The European corn borer (*Pyrausta nubilalis* Hubn.) is an insect of such potential destructiveness that it seems to me wise to make an annual report on it for several years longer until we know more definitely what the future of the borer in relation to corn growing in this province is going to be.

The last two years especially have shown that weather is a very big factor in determining the increase or decrease of the insect in any particular year. They also show that the critical period in the life of the insect is July and early August—the period when eggs are being laid and the young larvae are trying to establish themselves within the plant, where they can find moisture and protection.

You will remember that last year in most counties the weather in July and early August was very hot and dry, and that in all such counties, in the area under the Act, there was a distinct decrease of the borer. This year we have had very different weather, July and early August in most counties being warm and moist from frequent showers. This seems to have been ideal weather for the insect, for in spite of a fairly good clean-up last spring we have had a larger increase of the borer than at any time since 1926, when the Corn Borer Act came into force. This season has shown, I believe, that in spite of as good a clean-up of corn remnants as is practicable at present, all we can hope to do in a season like this is to prevent an increase. We cannot make a decrease. This is apparently proven in

*Metcalf and Flint, *Destructive and Useful Insects*, page 319.

the case of Norfolk County, where the weather was of the kind we have just mentioned and where the clean-up was as good as in any county in the province. In 1930 Norfolk had 5.1% of all stalks infested. This year it had 5.2% or practically the same. In counties where the clean-up was not as good the borer increased, in some cases very noticeably.

The greatest increase took place in Essex, where there are nearly twice as many borers in 1931 as in 1930. In Kent, Elgin, Middlesex and a few other counties the increase, as far as I can judge, runs from 30 to 60 per cent. In most of the rest of the counties it is from 5 to 25 per cent. Three counties—namely, Durham, Prince Edward and Welland, seem to have had a reduction. We are not sure just what the situation is in Hastings. The inspection in it indicates a decided reduction, but unfortunately owing to a severe drought and hot weather late in the summer and fall, much of the crop had been cut before the inspection could be done and therefore the figures obtained are not necessarily representative of the facts.

LITTLE DAMAGE DONE TO THE CROP

In spite of a general increase in the number of the borers, very few fields, probably not more than a dozen or two dozen at the most, were ruined or even suffered severe damage. This was largely because in the worst infested counties, as Essex and Kent, there was a large increase in the acreage this year over last and most of the corn was planted about the same time, so that the borers were more evenly distributed than last year.

Let me add in passing that Essex and Kent have had the best crop of corn this year since the great outbreak of the borer in 1926. The rest of the Province too except parts of the East has had an excellent crop.

THE INCREASE PROBABLY A BLESSING IN DISGUISE

I have felt for the last year that if the borer were to make a very noticeable increase for a season it would be a blessing to all concerned because many of the farmers had begun to think that there was no longer anything to fear from the insect and that the Corn Borer Act should therefore be less strictly enforced. But now I hope that they will see that when we told them the borer was just as dangerous as ever and could only be kept in control by a strict enforcement of the Act, we were speaking the truth.

THE SITUATION IN THE NORTHERN PARTS

Owing to reports of the rapid increase of the borer in Manitoulin Island I visited the district last August and was pleasantly surprised to find that the infestation was very light, only a very rare field or plot having more than 1 per cent. of the stalks infested. Dominion scouts later in the season found the average infestation to be 1.4 per cent.

Examination of fields and plots in Simcoe Grey and Bruce indicated that in these localities the borer this year was scarcer than we had expected and that there was no need at present of putting them under the Act.

NEW TERRITORY PLACED UNDER THE ACT

The only new territory brought under the Act this year is the southern part of the county of Lennox and Addington. In it the borer had become so abundant that some fields of sweet corn could not be harvested.

All along Lake Ontario and the St. Lawrence River the pest seems to be gradually increasing and I am afraid that all the land for five or six miles back from the water may have to be put under the Act before long.

INTRODUCTION OF LOW-CUTTING ATTACHMENTS

We have spent a good deal of time this year in testing out more fully the low-cutting attachments for corn binders. Mr. R. W. Thompson had charge of this work. A skilled Massey-Harris mechanic was hired to help him. One month was devoted partly to finding farmers in various localities who had Massey-Harris binders and were willing to try the low-cut attachments, and partly to testing them after they were put on the binders. Last year there were some defects in the knife used, but it has now been hardened by a stelliting process and set at a different angle. The result has been very encouraging, for the new attachment did good work, not only in clean corn, but also in very weedy and even in fallen corn. Unfortunately the International Harvester Company did not put their new attachment on the Canadian market. Had they done so we could have equipped many more binders with it and thus demonstrated its value on a much more extended scale. We have called the attention of the International Harvester field manager to the importance of introducing this new low-cut and expect they will do so next year.

We have also during the year endeavored through the press to have farmers plant only varieties of corn that are good yielders and sturdy enough to withstand a considerable attack by the borers without breaking down.

In conclusion I may say we hope the weather will not be specially favorable to the borer next year and that by extra care in clean-up and the gradual adoption by farmers of better methods of handling their corn fields, we may be able at our next annual meeting to give a more favorable report.

MYIASIS IN RANCH RAISED FOXES

A. A. KINGSCOTE

Ontario Veterinary College, Guelph

During the summers of the four years from 1927 to 1931 a number of cases of myiasis have been observed among foxes in the Provinces of Prince Edward Island, New Brunswick and Ontario.

With one exception these cases have always occurred in animals suffering from infectious or debilitating diseases, and the larvae have invariably been identified as members of the genus *Lucilia*. The exception in question was an infestation with the larvae of *Wohlfahrtia vigil* (Walk.) in a normal fox puppy four months of age. Four boil-like elevations were discovered on the abdomen of this animal. Each had a circular opening in it from 2 to 3 millimeters in diameter around which the fur was matted with exudations. The larvae were removed on the 22nd of July and were placed in a darkened jar and supplied with the muscle flesh of a fowl. They showed no inconvenience at the sudden change of temperature from that of body to room and in a few hours were feeding voraciously. On the fourth day they crawled together near the remainder of their food and commenced to pupate. The puparia gradually changed from light yellow to dark brown in colour. Eleven days later two flies emerged.

On this same ranch a litter of five mink were discovered with similar lesions on their thighs. The larvae were removed but unfortunately were destroyed

without having been identified. The coincidence in the time, place and similarity of the lesions, however, make it highly probable that this too was an infestation with the larvae of *Wohlfahrtia vigil*.

The larvae of the genus *Lucilia* or the "green-bottles" produce a variety of serious lesions. No records, however, are available to indicate that they ever produce myiasis in healthy foxes. It is during the course of infectious diseases such as distemper or paratyphoid infections that myiasis occurs. There are two possible explanations of this fact. The first is that an animal in ill-health is disinclined to protect itself from flies. The second is that a rise in body temperature accompanied by the impairment in physiological function of the kidneys and digestive system result in a distinct change of body odour. It is at this time that *Lucilia* instinctively takes advantage of the fact that an animal in such ill-health will prove a suitable medium upon which to oviposit. To perform this function the flies usually select a thin-skinned area where there is moisture and absence of hair. The favourite locations are at the commissures of the mouth, and in the region of the perinaeum. Other common sites for oviposition are inside the forearms and along the ventral floor of the abdomen. The minute first stage larvae immediately seek refuge from the light by entering the mouth, penetrating into the depth of the external auditory canal or by finding their way under the skin. The area between the thighs is the most common place for larvae to enter the subcutaneous tissues. Here the skin is very thin and a small injury produced by irritating discharges or by gnawing presents the avenue of entrance required. The exudates which soon accumulate at such a point attract other larvae from adjoining regions and large numbers will enter through the comparatively small opening or openings. They advance steadily forward below the skin on the abdominal cavity carrying with them various proteolytic organisms to which the host animal has little or no resistance; thus the larvae obtain a suitable and abundant food supply. A post-mortem examination upon an animal two or three days after infestation reveals a necrotic, irregular triangular area with its apex near the perinaeum and its base towards the pectoral region and extending up the sides of the thoracic wall. At this stage the skin is partially separated from the underlying structures and in the passages thus formed the larvae occur in great numbers and various stages of development.

Auricular myiasis, although not so frequent as the abdominal form, is serious. It is often associated with the presence of the ear mite *Otodectes cynotis* var. *canis*, but has not been observed except in foxes suffering from a debilitating disease at the same time. The larvae migrate downwards into the depth of the external auditory canal, the inflammatory exudates rapidly increase and supply abundance of food material. When the infestation is unchecked the tympanum is destroyed and the middle ear becomes invaded by the larvae and putrefactive-bacteria. The thin partition of bone between the middle ear and the brain soon becomes involved and fatal cerebro-meningitis results.

Autopsies upon animals immediately after death will expose larvae in the nasal passages, pharynx and occasionally in the trachea. In a few instances larvae have also been located in the stomach; however, they are generally dead and have in all probability reached this organ by being swallowed.

In one instance one hundred and eighty-five larvae were collected from living and recently dead foxes. These were placed in a darkened jar with a supply of earth and flesh. In due course one hundred and thirty-seven flies emerged and were identified as *Lucilia caesar* Linn.

The prevention of myiasis in the fox ranches is an important and interesting matter. Once a serious infestation has occurred in a living animal there is usually meagre hope of its recovery. Death usually follows in two or three days. How-

ever, if animals are protected, the mortality, even during the course of an infectious disease, may be reduced. Unfortunately many ranchers look upon flies as a necessary evil during the summer months. A ranch to a casual observer may appear clean and tidy, but a more careful survey of the premises will usually reveal several suitable breeding places for flies. These are generally in distant corners, behind trees or sheds and consists of piles of fox manure, dirt and straw from the sheds and dens, improperly constructed pits where offal, bones and spoiled food are discarded. The changes in sanitation necessary to eliminate these breeding places suggest themselves. Fly traps and screens may also be utilized to advantage in various places on the ranch.

It is the animals which from time to time become sick on the ranches which require the greatest attention to prevent the occurrence of myiasis. It is not as a general rule practical to have them placed in fly-proof pens, but the uses of repellants and the application of medicated ointments to the parts on which the flies usually oviposit are valuable. Pyrethrum-kerosene applied as a light spray to the fur two or three times daily is quite satisfactory and does not harm the animal in any way. Pen floors lightly dusted with slaked lime are less attractive to the flies than bare floors.

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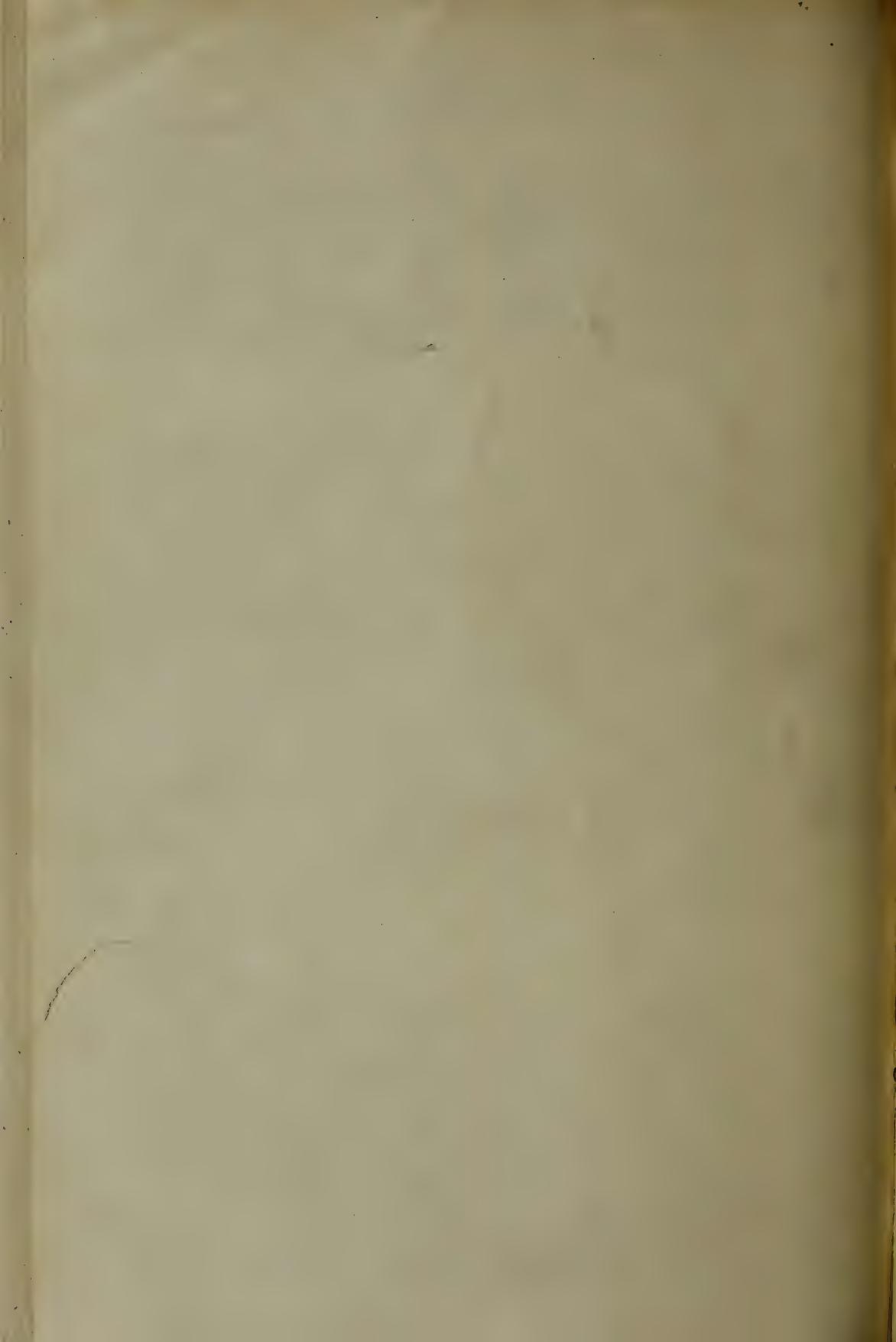
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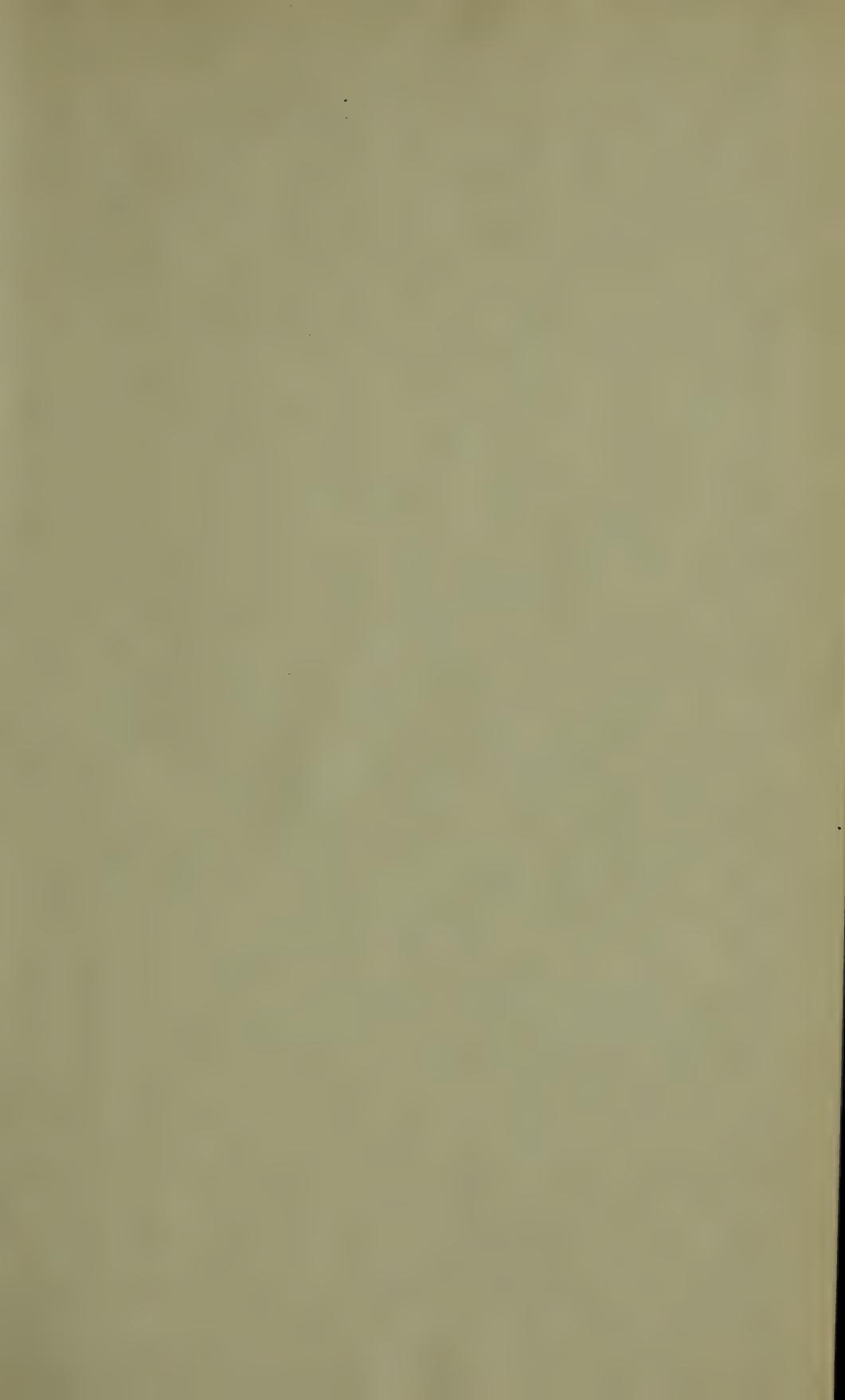
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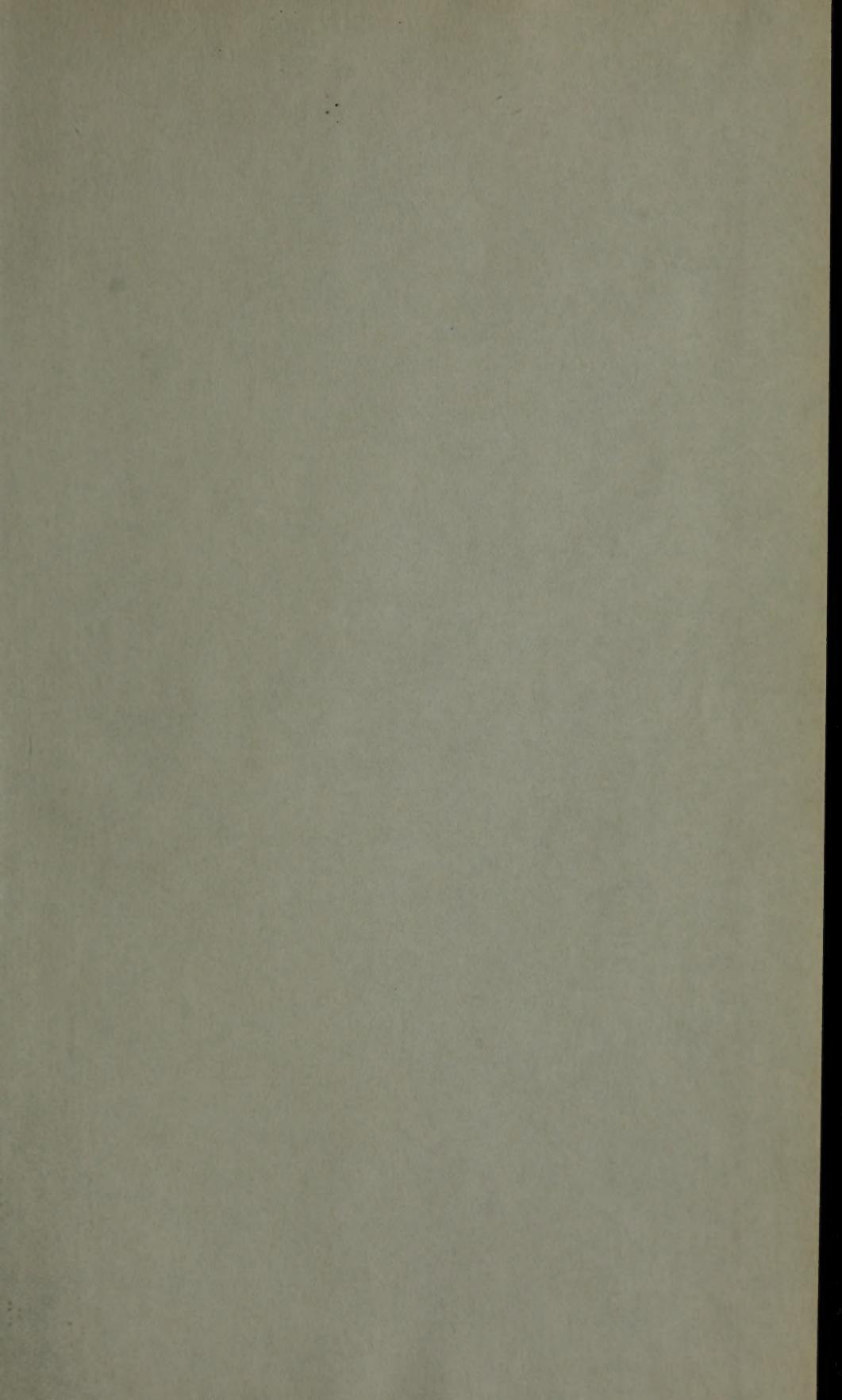
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